

Montana Forest Insect and Disease Conditions and Program Highlights - 2010



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Forest Health
Protection
Report 11-1



Montana
Department of
Natural Resources
and Conservation
Forestry Division



Conk of *Inonotus
tomentosus*



Pruning Douglas-fir Dwarf Mistletoe in
Wayfarers State Park

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MONTANA

Forest Insect and Disease Conditions and Program Highlights – 2010

Report 11-01

2011

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Conk of *Inonotus tomentosus*, by Blakey Lockman, USDA Forest Service

**Pruning Douglas-fir Dwarf Mistletoe in Wayfarers State Park, by Amy Gannon,
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TABLE OF CONTENTS

ABBREVIATIONS.....	1
INTRODUCTION.....	2
SUMMARY OF CONDITIONS	2
Bark Beetles	2
Defoliators	3
Mortality Complexes.....	4
Root Diseases	4
Foliage Diseases.....	5
Dwarf Mistletoes	5
White Pine Blister Rust	5
Abiotic Damage.....	6
ANNUAL AERIAL DETECTION SURVEY	7
INSECT AND DISEASE CONDITIONS BY COUNTY	8
COMMON AND SCIENTIFIC NAMES	48
PUBLICATIONS 2010	49
DIRECTORY OF PERSONNEL.....	53

LIST OF TABLES

Table 1	Stand Conditions and Mortality Rates Detected within Mountain Pine Beetle FINDIT Plot Clusters Established during 2010.....	40
Table 2	Mortality, Defoliation and Other Damage detected from the air on National Forests, National Parks and Tribal Lands in Montana during 2010	44
Table 3	Acres of Host Type Infested by Bark Beetles on All Ownerships in Montana during 2010	55
Table 4	Acres of Host Type Infested by Bark Beetles in Montana, 2008 Through 2010.....	56
Table 5	Acres with Douglas-fir Beetle-Caused Mortality on All Ownerships in Montana, 2008 Through 2010	57
Table 6	Acres with Mountain Pine Beetle-Caused Mortality on State and Private Lands in Montana, 2008 Through 2010	58
Table 7	Acres with Mountain Pine Beetle-Caused Mortality on All Federal Ownerships in Montana, 2008 through 2010	59
Table 8	Acres with Additional Bark Beetle-Caused Mortality on All Ownerships in Montana, 2008 Through 2010.....	60

LIST OF FIGURES

Figure 1	FINDIT Plot Clusters Depicting Rate of Mountain Pine Beetle-Attacked Trees in 2010 Relative to 2009.....	39
Figure 2	Reporting Areas and County Boundaries in Montana	61
Figure 3	Areas Surveyed During the 2010 Forest Health Protection Aerial Detection Survey in Montana	62
Figure 4	2010 Mountain Pine Beetle Infestations in Montana	63
Figure 5	2010 Douglas-fir Beetle Infestations in Montana.....	64
Figure 6	2010 Fir Engraver Beetle Infestations in Montana	65
Figure 7	2010 Subalpine Fir Mortality Complex in Montana.....	66
Figure 8	2010 Western Spruce Budworm Infestations in Montana.....	67

ABBREVIATIONS

The following abbreviations are used throughout this document:

Beetles	BWA	=	Balsam woolly adelgid, <i>Adelges piceae</i> Ratzeburg
	DFB	=	Douglas-fir beetle, <i>Dendroctonus pseudotsugae</i> Hopkins
	ESB	=	Spruce beetle, <i>D. rufipennis</i> (Kirby)
	FE	=	Fir engraver, <i>Scolytus ventralis</i> LeConte
	IPS	=	Pine engraver, <i>Ips pini</i> (Say)
	MPB	=	Mountain pine beetle, <i>D. ponderosae</i> Hopkins
	RTB	=	Red turpentine beetle, <i>D. valens</i> LeConte
	WBBB	=	Western balsam bark beetle, <i>Dryocoetes confuses</i> Swaine
	WPB	=	Western pine beetle, <i>D. brevicornis</i> LeConte
Defoliators	DFTM	=	Douglas-fir tussock moth, <i>Orygia pseudotsugata</i> McDunnough
	GM	=	Gypsy moth, <i>Lymantria dispar</i> L.
	LCB	=	Larch casebearer, <i>Coleophora laricella</i> Hübner
	WSBW	=	Western spruce budworm, <i>Choristoneura occidentalis</i> Freeman
Hosts	DF	=	Douglas-fir
	ES	=	Engelmann spruce
	GF	=	Grand fir
	LP	=	Limber pine
	LPP	=	Lodgepole pine
	PP	=	Ponderosa pine
	SAF	=	Subalpine fir
	WBP	=	Whitebark pine
	WL	=	Western larch
Other	WWP	=	Western white pine
	BLM	=	Bureau of Land Management
	FIA	=	Forest Inventory and Analysis
	FS	=	Forest Service
	NF	=	National Forest
	NP	=	National Park
	IR	=	Indian Reservation
	RA	=	Reporting Area
	RD	=	Ranger District
	TPA	=	Trees Per Acre

INTRODUCTION

This report summarizes the major forest insect and disease conditions in Montana during 2010 and was jointly prepared by the Montana Department of Natural Resources and Conservation, Forestry Division and USDA Forest Service (FS), State and Private Forestry, Forest Health Protection (FHP), Northern Region.

Information for this report was derived from ground and aerial surveys within Reporting Areas (RA) across parts of Montana. A Reporting Area includes all federal, state, and private land ownerships within a particular geographic boundary (Figure 2).

SUMMARY OF CONDITIONS

Bark Beetles

According to aerial and ground survey data, bark beetle activity in Montana declined overall in 2010. This is based on aerial surveys of approximately 23 million acres of forested land in the state in 2010 compared with 27.8 million acres surveyed in 2009. The decrease in survey area as well as differences in recording techniques among aerial surveyors explains part of this decline in beetle activity. Mortality may have been slightly underestimated in some locations due to late-season crown discoloration (fading) occurring post-aerial survey flight. However, ground observations do indicate a decrease in levels of beetle activity in many areas, especially MPB, with depletion of susceptible host material. Table 4 provides a breakdown by insect and host type of the 2,205,971 acres mapped as infested by bark beetles in 2010.

For several years MPB has been most active in the west-central portion of Montana. In 2010 infested acreage declined around Helena, Butte, and Bozeman in both LPP and PP, attributable largely to lack of remaining live, susceptible host trees. Other areas of the state did see an increase, notably in LPP and PP on and around the Bitterroot and Flathead NFs. Fort Belknap IR and Rocky Boys IR continued to see MPB activity in PP with some increase in area infested. Activity in WBP and LP have decreased by about half in the state. Only the Flathead and Deerlodge NFs noted any sizeable increase in MPB activity in these hosts. The severity of MPB in 5-needle pines declined on average with a mortality rate of 4.5 trees per acre in 2009 compared with 3.8 trees per acre recorded in 2010.

Significant drops in temperature were recorded several times in winter 2009-2010 in much of western Montana. Weather is the principle mortality agent of MPB, with extreme drops in temperature during fall and spring being particularly detrimental to MPB. Temperature drops in October, November, and December 2009 may have contributed to mortality of overwintering larvae. Ground surveys in 2010 support the idea that larval mortality was high in some areas. In most areas surveyed, the ratio of 2010 / 2009 attacked-trees (green: red attack ratio) ranged from 0 to 0.5, indicating a > 2-fold reduction in MPB populations within these site-specific plots. Some degree of active 2010 MPB populations, even if declining, was usually found. On some sites

populations significantly increased with green: red ratios suggesting 12- to 15-fold increases in activity. We suspect mortality was higher in thin-barked LPP than in the more insulated, thick-barked PP. Figure 1 provides data on numbers of infested trees in 2009 compared with 2010 based on FINDIT ground surveys. Changes in activity levels were highly variable spatially. The long-term effect of this weather event on MPB is unknown, but it is likely that tree mortality in local areas will be reduced for several years. A resurgence in mortality is likely in areas where considerable host material remains, dependant partly on future weather conditions

Douglas-fir beetle infested acres continued to decline in 2010 throughout most of Montana. State-wide area estimates for acres of DFB-caused mortality decreased from 22,459 acres in 2009 to 14,689 acres in 2010. Approximately 31,000 beetle-killed DF were recorded on these infested acres this year. Some increases were noted in the Bitterroot, Gallatin, and Lewis and Clark RAs, but most areas were at or near endemic levels. If cool, moist weather conditions continue, it is expected DFB will remain at low levels.

Engelmann spruce beetle remained at low levels across the state. However, an area of significant activity was identified on the Madison Ranger District of the Beaverhead-Deerlodge NF in the Gravelly Mountains. Most activity was detected along Standard Creek and Cottonwood Iron Creek near Black Butte Work Station. Another area of ESB activity was found along the Beartooth Highway outside of Red Lodge on the Custer NF. Spruce in several campgrounds along Rock Creek have been infested with ESB for several years, driven in part by windthrow. Ground surveys indicated active, viable ESB populations in both of these areas and tree mortality is expected to continue in subsequent years.

Fir engraver beetle activity dropped considerably. Part of the decline is attributable to the lack of survey in areas dominated by grand fir. Areas surveyed, however, did show a continued decline in activity and ground surveys of other areas indicate this is true over a larger area. Continued cool, wet weather will benefit GF, likely keeping FE at endemic levels.

Neither IPS nor WPB showed significant activity with both decreasing in 2010. Both were found at very low levels, likely a continuing result of near normal precipitation for several years.

Defoliators

Western spruce budworm continues to be the most significant defoliator in Montana. In 2010, 325,548 acres were mapped as defoliated by WSBW, mainly in DF in northwestern and central Montana. This is a considerable decline from the nearly 2.6 million acres reported in 2009. Most of the 2010 defoliation was in Beaverhead, Flathead, Gallatin, Lewis and Clark, Lincoln, Park, and Sanders counties with each reporting over 15,000 acres.

Defoliation by DFTM was not reported in Montana in 2010. A small area with LCB defoliation was recorded on 117 acres in Sanders County.

Cooperative detection monitoring continued for GM in 2010 with USDA Animal and Plant Health Inspection Service, Montana Department of Agriculture, Montana Department of Natural Resources and Conservation, and USDA Forest Service. A network of more than 1,000 pheromone-baited traps were placed throughout Montana's forests and urban areas most frequented by travelers. No gypsy moths were detected in Montana in 2010.

BWA was confirmed through ground surveys in Ravalli, Mineral, Lincoln, and Sanders Counties.

Mortality Complexes

Mortality of SAF partly attributed to WBBB, often in concert with other agents, declined in 2010. Observed mortality was scattered across western Montana at fairly low levels. Mortality was primarily detected on federally-managed lands (86%) located within the Flathead, Lewis and Clark, and Beaverhead-Deerlodge RAs. Unless weather conditions become more favorable to the beetle it is not expected that SAF mortality will increase significantly.

Dieback of aspen was mapped where crown symptoms were sufficiently apparent and surveyors had the opportunity to delineate these stands while focusing on capturing bark beetle activity. The lack of mapped polygons in an area, however, does not mean there are no aspen health concerns in the area. Of the over 7 thousand acres mapped the concentration was along the Rocky Mountain Front in Glacier and Pondera Counties (5,891 acres) principally on tribal and private lands. Other mapped spots were scattered across the landscape, principally east of the Continental Divide in the Little Belt, Bridger, Gallatin, and Madison Ranges (Cascade, Meagher, Park, Gallatin, and Madison Counties).

Root Diseases

Root diseases are diseases of the site and do not change drastically from one year to the next. Root disease fungi cause damage and mortality on well over 7 million acres in western Montana, killing more than 30 million trees annually. Root disease-caused mortality is more common west of the Continental Divide, affecting all age classes of DF, GF, and SAF, and to a lesser extent, younger age classes of all conifer species. Large areas of root disease can be found east of the Divide, but it tends to occur in more discrete patches, rather than being ubiquitous throughout an area. Also, root diseases can be commonly found in riparian areas east of the Continental Divide, often in spruce and subalpine fir. The most impacting root diseases are Armillaria root disease (over 6 million acres), laminated root disease (almost 200,000 acres), annosus

root disease (almost 2 million acres of fir annosus), schweinitzii root and butt rot (acreage unknown), and to a lesser extent tomentosus root disease (acreage unknown).

Foliage Diseases and Tip Blights

Over 2,000 acres of lodgepole pine needle cast were identified by ADS in Flathead, Lake and Glacier counties.

Over 1500 acres of Diplodia tip blight were identified by ADS. Affected acreages were concentrated in Lake County (1507 acres), but were also noted in Flathead (39 acres) and Sanders (28 acres) Counties.

Dwarf Mistletoes

Historical assessments of dwarf mistletoe stands in Montana show that about 16% of DF, 33% of LPP, and 30% of WL stands are infested with dwarf mistletoe. More recent assessments using Forest Inventory and Analysis data collected on over 50,000 trees across Montana show that only about 1% of DF, 3.2% of LPP, and 3.9% of WL trees were infected. Within any infected stand, individual trees may range from uninfected to severely infected. The clumpy nature and protracted disease cycle of dwarf mistletoe is likely the reason for a discrepancy between these two measurements; the first is measuring infected stands and the second is measuring infected trees.

White Pine Blister Rust

Western white pine, whitebark pine, and limber pine are all susceptible to white pine blister rust.

Western white pine

Mature WWP continue to be lost due to a combination of blister rust and MPB. Lack of suitable sites, either man-made or natural, limits natural regeneration, and white pine blister rust may kill a high proportion of natural seedlings. Resistant stock is planted operationally on suitable WWP sites on federal, state, industrial, and private forest lands throughout northwestern Montana. In addition to planting rust-resistant stock, pruning of the lower bole is an important tool used in blister rust management.

Whitebark pine

White pine blister rust has been impacting WBP ecosystems for many decades. In addition, recent outbreaks of MPB have caused widespread mortality in many WBP stands already impacted by white pine blister rust. The combination of white pine blister

rust, bark beetle outbreaks, and lack of natural regeneration due to fire suppression has raised concerns about the long-term viability of WBP ecosystems.

A recent survey by Forest Health Protection of WBP stands throughout Idaho and Montana found that of the 42 sampled stands, 69% have less WBP regeneration than that of other species such as SAF and ES. White pine blister rust infection varied from 0% to 81% in these stands, and 40% had infection levels greater than 20%. Taking into account the ongoing impacts of white pine blister rust and bark beetles, the report concludes that approximately 75% of these stands will convert to other species without active restoration efforts or the occurrence of wildfire.

Standardized methodology is now being used to establish monitoring plots in WBP stands throughout the West. These plots are designed to provide a statistically-based assessment of the incidence of white pine blister rust in the ecosystem and the condition of WBP. A database has been developed at <http://www.fs.fed.us/r1-r4/spf/fhp/prog/programs2.html> to compile and provide results of surveys in both WBP and limber LP. This database is scheduled for improvement and update in 2011, and will become web-accessed and updated via a password protected system.

Limber pine

Limber pine is found at elevations ranging from 2,700 feet near the community of Terry in far eastern Montana to around 9,000 feet in and around the Beaverhead-Deerlodge NF in southwestern Montana. West of the Continental Divide, LP is largely confined to limited areas adjacent to the Divide, while scattered populations of LP can be found across much of eastern Montana. An area not historically documented as including LP (through FIA or the LP-specific studies) is in the Little Rocky Mountains in north-central Montana. White pine blister rust is found throughout the distribution of LP, but there are a few areas where LP remains apparently free of the disease including spots southwest of Ennis and south of Billings. More detailed information about the current amount, distribution, and condition of LP in Montana can be found in a recently published document, "Current Status of Limber Pine in Montana" (Jackson and others 2010).

Limber pine seeds were collected from one Montana site in 2010, the Logging Creek area of the Lewis and Clark National Forest, for inclusion in a west-wide collection being carried out for gene conservation, white pine blister rust resistance screening, and various research projects.

Abiotic Damage

Just over 1300 acres of wind throw were mapped in 2010. These acres were distributed among 4 counties: Lincoln (19 acres), Madison (727 acres), Meagher (423 acres), and Park (173 acres). Very minor acreages were mapped for winter injury (119 acres total), flooding (35 acres total), and avalanche damage (50 acres) and are duly noted in each affected county.

ANNUAL AERIAL DETECTION SURVEY

Aerial detection surveys are an overview survey designed to locate and document forest change events, as seen from the air. It is a form of data collection that allows the observer to survey large tracts of forested land, in a relatively short period of time. Single engine, high-wing aircraft, flying at speeds of approximately 90 to 130 mph, at an average altitude of 1,500 feet above terrain level are used to contour fly the ridge lines within a RA. The damage extents or polygons of the aurally detected signatures of recently killed or defoliated trees are marked on a digital sketchmapping system. These polygons are given a code for the agent that likely caused the damage; inferred from the size and species of trees affected, as well as the color and pattern of the damage. The agent code is followed by the number of trees affected, trees per acre affected or an intensity of the damage (L for light and H for heavy). Areas burned by wildfire are not surveyed until the third year following a fire as it can be difficult to distinguish mortality caused by fire from that caused by insect or disease activity. The actual amount of mortality from tree diseases, dwarf mistletoes, and white pine blister rust are greatly underestimated with aerial detection surveys as symptoms from these agents can be difficult and in some instances impossible to identify from the air.

Much of the data summarized in this report is a product of the annual aerial detection surveys, as well as ground surveys and biological evaluations. The digital data files, data summaries, and aerial detection survey damage maps are available from the Missoula FHP Field Office, in both paper and digital GIS format. Data may also be downloaded at <http://www.fs.usda.gov/goto/r14-ADS>.

The annual aerial detection survey in Montana was conducted from June 24 thru September 30, 2010. The survey encompassed approximately 23 million acres of mixed ownership forested lands, excluding most wilderness areas (Figure 3). Four FHP observer's, using three contract aircraft, performed the 2010 aerial survey and identified 2,524,738 acres of forest damage.

INSECT AND DISEASE CONDITIONS BY COUNTY

County Areas in Detail

County summaries follow. For each, damage effects on their respective ownership are noted. To the extent possible, we have indicated areas affected and an estimate of extent. Counties not listed had no reported information. Forestland data in the following tables are from the annualized surveys performed by USDA Forest Service Forest and Inventory Analysis (<http://www.fia.fs.fed.us>). In some of our tables, you will observe acres of damage on some ownership where there is no forestland reported. Because of the limited forestland within ownerships of some counties the density of FIA plots may not have been sufficient at the county level to identify acres. This discrepancy is within their standard of error. Other Federal lands include tribal ownership.

Beaverhead County

Acres of Forestland, Mortality, and Defoliation by Ownership (**1,772,254 acres surveyed**)

	National Forest	Other Federal	Private	State	Total
Forestland	1,072,813	131,357	16,607	41,141	1,261,918
Dieback	33	0	0	0	33
DFB	38	6	0	0	44
ESB	303	8	0	0	311
MPB-LPP	163,132	9,801	5,910	2,643	181,486
MPB-High Elevation	39,845	367	353	88	40,653
SAF Mortality	1,164	0	0	0	1,164
WSBW	20,149	3,011	1,595	1,186	25,941

The same amount of area was surveyed in 2010 as in 2009 with the exception of an island of BLM land in the center of the county and a portion of the central Pioneer Mountain corridor. MPB in LPP significantly increased on both sides of the Big Hole valley (western Pioneers, and Beaverhead and Anaconda Ranges) in many areas where little to no previous activity was noted. MPB in 5-needle pines continues at levels similar to those detected in 2009. Most activity was noted in the eastern Pioneer Mountains, with significant patches between Lemhi and Bannock Passes, and Maiden Peak area, although some activity can be found in most areas with host type.

Ground plots were installed within the Big Hole drainage, up the Pioneer By-Way and at Chief Joseph Pass in stands dominated by LPP. Ground surveys from the spring and previous fall suggested that the Big Hole and Pioneer Mountains experienced considerable mortality of larvae during the October 2009 cold snap (MFO-TR-10-10). Whether due to this event alone or in combination with a cool, wet spring/summer and/or host depletion, ground surveys in the Big Hole and Pioneer Byway showed a significant decrease in 2010 MPB activity in many areas where MPB had been active in

2009. Interestingly, fading of 2009-attacked trees also appeared to be delayed, possibly affecting detection during aerial survey. Cumulative mortality numbers (>15%) also reflect the MPB-activity front radiating southwest from Butte with a second front moving east over the Continental Divide from Idaho and Chief Joseph Pass.

ESB activity, although still low, was detected in significant patches on the southern ends of the Snowcrest and Gravelly mountains. A large increase in acres with SAF mortality was noted in 2010, particularly at the south end of the Snowcrest Range. A few, small scattered spots were also noted at the north end of the Pioneers. DFB continued to be low, likely due to cooler, moister weather. Aspen dieback acres were lower, largely corresponding to no aerial survey of the Centennial Mountain area in 2010.

WSBW activity decreased throughout the county. The concentration of activity was still on the eastern side of the Pioneers, although some activity was noted in nearly all areas where host trees are prevalent.

White pine blister rust is common in WBP in this county. Schweinitzii root and butt rot is common in DF, causing decay in the butt logs but not acting as an aggressive root pathogen. Lodgepole pine dwarf mistletoe and limber pine dwarf mistletoe are present in the county.

Big Horn County

Aerial detection surveys were not conducted in Big Horn County in 2010. Field visits to Crow IR lands in the Bighorn and Pryor mountains generally found endemic MPB and other bark beetle populations with activity similar to that noted in 2009. SAF mortality associated with WBBB and other damage agents was noted throughout the Black Canyon and Red Springs areas in the Bighorn Mountains. It was the most significant damage observed and occurred at similar levels as documented in 2009 (MFO-TR-10-28).

White pine blister rust and limber pine dwarf mistletoe were involved in mortality of LP south of the outlook above Black Canyon Youth Camp (MFO-TR-10-28). Significant foliar disease (likely Marssonina Blight) was noted in an aspen grove in the Rotten Grass Drainage in the foothills of the Bighorn Mountains (MFO-TR-10-28). Long-term damage is not expected. Lodgepole pine dwarf mistletoe along with limber pine dwarf mistletoe are present in the county.

Blaine County

Acres of Forestland, Mortality, and Defoliation by Ownership (47,419 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	0	80,431	91,752	0	172,183
MPB-LPP	0	591	0	53	644
MPB-PP	0	352	1,454	2	1,808
MPB-High Elevation	0	4	0	0	4

Increasing MPB-caused tree mortality was recorded in both LPP and PP in the Little Rocky Mountains on the Fort Belknap IR. MPB activity increased nearly 4-fold in LPP. In PP there was a 20-fold increase in acres affected and an almost 40-fold increase in TPA killed. Low and scattered PE activity occurred on tribal lands. Continued PE suppression activities are probably responsible for keeping PE activity low.

Lodgepole pine dwarf mistletoe is present in the county.

Broadwater County

Acres of Forestland, Mortality, and Defoliation by Ownership (409,968 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	149,833	26,456	101,048	0	277,377
DFB	10	0	0	0	10
MPB-LPP	36,438	33	5,936	0	42,407
MPB-PP	1,386	1,061	12,920	915	16,282
MPB-High Elevation	4,161	1,066	1,153	8	6,388
WSBW	6,333	2	5,033	53	11,420

MPB was by far the most significant mortality agent on lands surveyed. Number of acres affected by MPB increased significantly in higher elevation WBP and PP forests. Number of acres of LPP impacted by MPB remained about the same. However, TPA killed by MPB decreased across all host types. It will probably continue to decrease in intensity over the next few years as the host is depleted. WSBW decreased nearly 10-fold across the county. However, there are still pockets of trees heavily defoliated from WSBW.

White pine blister rust has been found in LP in this county. Armillaria root disease is present in the county, and schweinitzii root and butt rot is quite common, especially causing significant decay in the butt logs of larger, older DF. Lodgepole pine dwarf mistletoe is present in the county.

Carbon County

Aerial detection surveys were not conducted in Carbon County during 2010. Ground surveys noted numerous green-attacked trees and continued ESB-caused mortality throughout the Rock Creek drainage on the Custer National Forest. Mortality occurred in numerous pockets that averaged 3-5 (range 2-15) trees/group that faded primarily between 2009 and 2010 (MFO-TR-10-18). WSBW and DFB activity has also been noted from ground surveys.

Spruce broom rust is prevalent in various campgrounds in this county (MFO-TR-10-18). Tomentosus root disease in spruce was positively identified at several campgrounds in 2010 (MFO-TR-10-18). Decay and fruiting bodies were found and collected from Sheridan Campground for a small study looking at tomentosus root disease in eastern Montana. White pine blister rust is common in WBP and LP. Lodgepole pine dwarf mistletoe and limber pine dwarf mistletoe are present in the county.

Cascade County

Acres of Forestland, Mortality, and Defoliation by Ownership (**403,895 acres surveyed**)

	National Forest	Other Federal	Private	State	Total
Forestland	211,401	8,722	98,038	10,127	328,288
Dieback	45	0	25	0	70
DFB	63	3	19	2	87
MPB-LPP	45,423	3,661	12,940	1,143	63,167
MPB-PP	6,784	3,206	18,691	1,110	29,791
MPB-High Elevation	4,030	101	316	10	4,457
SAF Mortality	200	0	2	0	202
WSBW	8,442	1,171	3,249	1,337	14,199

About 2/3rds of the area surveyed in 2009 was resurveyed in 2010, with the decrease principally in privately owned lands. The same FS managed lands were surveyed both years. MPB activity in LPP continued in the same areas as 2009. Overall, acres with MPB activity increased, with trees per acre killed decreasing in the lower elevations (BLM, state and private). FS lands, however, not only show half-again as many acres of LPP affected, but 1/3 more trees killed. Fewer acres of MPB activity were detected in 2010 in PP, with a significant decrease in the number of trees, again largely on BLM, state and private lands. Within FS lands, however, there was nearly a 4-fold increase in acres and 2.4-fold increase in number of trees recorded. The highest concentrations of activity were found along the north end of the Big Belt Mountains. MPB remained active in 5-needle pines in the Little Belt Mountains with a significant, large, new polygon noted in the mountains between Pilgrim and Tillinghast Creeks. MPB activity has reportedly decreased in community trees in the City of Great Falls.

SAF mortality remained relatively low, with clear decreases on FS lands to about half of 2009 levels.

WSBW caused defoliation of appreciable levels greatly declined in 2010 from over 85,000 acres to little more than 14,000.

White pine blister rust is common in LP in this county. Armillaria root disease is present in the southeastern portion of the county, and schweinitzii root and butt rot is quite common, especially causing significant decay in the butt logs of larger, older DF.

Chouteau County

Acres of Forestland, Mortality, and Defoliation by Ownership (**168,740 acres surveyed**)

	National Forest	Other Federal	Private	State	Total
Forestland	19,254	0	36,148	1,939	57,341
DFB	2	6	26	0	34
MPB-LPP	14,777	1410	3,348	42	19,577
MPB-PP	0	394	868	420	1,682
MPB-High Elevation	2	0	4	0	6
WSBW	286	87	124	0	497
Windthrow	5	0	0	0	5

Number of acres of MPB-killed LPP remained at about 2009 levels on tribal lands. However the number of LPP killed increased in some areas. Number of acres of PP impacted by MPB increased 3-fold on Rocky Boys IR, near Salt Coulee and Sawmill Butte. However, in most areas the intensity (or TPA) killed by MPB decreased. Limited MPB activity was recorded in high elevation WBP stands. WSBW activity significantly decreased across forested lands in the county probably as a result of an increase in precipitation in 2010. DFB activity remained at low levels.

ADS mapped in a small polygon of wind throw (5 acres) in the east side of Highwood Baldy Mountain on the Lewis and Clark NF in the southwest corner of the county. Armillaria root disease is present in the northern portion of the county on the Rocky Boys IR, but appears to be uncommon. Butt rot and breakage caused by *Ganoderma applanatum* has been observed in quaking aspen on the Rocky Boys IR.

Deer Lodge County

Acres of Forestland, Mortality, and Defoliation by Ownership (283,820 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	211,103	8,678	44,188	32,285	296,254
Dieback	0	0	21	0	21
DFB	4	0	14	10	28
MPB-LPP	31,443	555	18,231	8,422	58,651
MPB-PP	0	0	41	0	41
MPB-High Elevation	1,584	0	6,492	2	8,078
SAF Mortality	4	0	0	0	4
WSBW	14	0	426	11	451

Slightly fewer acres were flown in 2010 (west end of the Fleece mountains under FS management were excluded), although outside of wilderness and the I-90 corridor most of the county was surveyed. MPB in LPP dropped to less than half previous levels although some activity continued throughout the county where ever host was present. Three ground plots (FINDIT) in LPP were measured along the southeast edge of wilderness near Pintler and Seymore campgrounds. MPB activity greatly varied, with little new activity to spots of very intense, successful 2010 activity. Very little MPB activity in PP was noted, with a few patches mapped along the far southeast edge of the Flint Mountains on private lands. MPB in 5-needle pines more than doubled in acres affected despite no 2010 survey of 5-needle pine areas in the Fleece Mountains with mortality in 2009; number of trees estimated dead increased more than 7-fold. Areas of greatest increase, especially in areas where mortality was not previously noted, include the Flint Mountains (Lost Creek) and Mt. Haggin areas, mostly on private lands.

Little activity by DFB or ESB, or mortality in SAF was detected. WSBW was detected in the southeast Flint Mountains (mostly private lands) although at much lower levels. New areas were noted northwest of Fairmont Hotsprings.

White pine blister rust has been found in LP in this county. Schweinitzii root and butt rot is common in DF, causing decay in the butt logs but not acting as an aggressive root pathogen. Lodgepole pine dwarf mistletoe and limber pine dwarf mistletoe are present in the county.

Fergus County

Acres of Forestland, Mortality, and Defoliation by Ownership (266,535 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	83,191	178,357	282,094	16,802	560,444
Avalanche	50	0	0	0	50
DFB	873	93	246	0	1,212
MPB-LPP	4,363	691	882	59	5,995
MPB-PP	1,329	1,296	7,400	364	10,389
MPB-High Elevation	41	13	1	0	55
SAF Mortality	16	0	0	0	16
Unidentified Defoliator	0	233	30	40	303
WSBW	3,969	154	1,376	7	5,506

Less than 1/3 the area surveyed in 2009 was resurveyed in 2010; 2010 survey was mostly of FS lands in the Snowy Mountains and BLM lands in the Judith Mountains. Most areas of MPB activity in LPP mapped in 2009 were resurveyed in 2010, suggesting that the near doubling of acres accurately represent activity in the area. Some increases were noted in the Judith Mountains, but the greatest increases were noted in the Snowy Mountains, especially in the headwaters of Rock and Buffalo Creeks. A significant portion of MPB activity in PP mapped in 2009 was not resurveyed in 2010, although area mapped was similar. As with LPP host, increased activity was noted in the Judith Mountains, with the biggest increases along the south and east edges of the Snowy Mountains on private lands. Increased activity in 5-needle pines occurred as small, scattered patches mostly on FS lands in the Snowy Mountains.

DFB activity was mapped as several large polygons along the northern FS border in the Smoky Mountains; SAF mortality was still noted in the central Smoky Mountains, although at decreased levels. Although a significant portion of WSBW activity was not resurveyed in 2010, areas that were resurveyed showed significant drops in acres of defoliation significant for mapping. The biggest decrease was noted throughout the northwest corner of the Snowy Mountains managed by the Forest Service.

A 50-acre polygon of avalanche damage was mapped in the Big Snowy Mountains, at the head of East Fork of Big Spring Creek during the 2010 ADS. Root disease patches, assumed to be Armillaria root disease, have been noted in the Big Snowy Mountains. Armillaria root disease was positively identified in the North Moccasin Mountains, north of Lewistown. Lodgepole pine dwarf mistletoe is present in this county.

Flathead County

Acres of Forestland, Mortality, and Defoliation by Ownership (2,581,563 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	1,680,148	519,715	418,105	154,800	2,772,768
Diplodia Canker	0	24	0	16	39
DFB	661	340	38	10	1,049
ESB	16	2	0	0	18
FE	118	5	3	0	126
Lophodermella concolor	158	61	412	0	631
MPB-LPP	35,167	8,885	1,215	319	45,586
MPB-PP	20	11	151	27	209
MPB-WP	2	0	0	0	2
MPB-High Elevation	3,298	0	4	0	3,302
IPS	0	0	0	2	2
SAF Mortality	5,423	103	12	153	5,691
WSBW	37,373	7,001	1,661	921	46,956

Except for MPB-caused pine mortality, bark beetle activity was fairly light. MPB decreased across most of the county. Ground surveys showed that MPB may be increasing on some parts of the forest to the north and west of Kalispell near Round Meadows recreation area. In 2010, ADS showed a significant number of acres of 5-needle pines killed by MPB along the continental divide in the Bob Marshall Wilderness. This area was not flown in 2008 or 2009 but we suspect that MPB has been active in this area for several years. Other bark beetle-caused mortality was recorded at endemic levels. DFB populations remained generally endemic in the western portion of the park in 2010 except for a few isolated locations.

Eighteen sets of FINDIT plots were established in the Granite Lodgepole project on the Middle Fork of the Flathead River (Hungry Horse Ranger District). The plots showed a large decrease in MPB activity in the project area. Very few new attacks were found. Some unsuccessful attacks by beetles were recorded. The majority of mortality occurred in 2008-2009.

Insect activity continued throughout the western portion of Glacier NP in 2010. Area surveyed varied greatly compared to 2009 where only the northwestern portion of Glacier NP was surveyed; thus, direct year to year comparisons are not feasible. 2010 surveys indicated continued WSBW defoliation and MPB-caused LPP mortality scattered throughout the western portion of the park. Consecutive years of widespread WSBW defoliation contributed to physiological stress that could promote increased DFB activity in subsequent years.

During the 2010 ADS, lodgepole pine needle cast was mapped on 631 acres. One large polygon (460 acres) is located on private landholdings within the west side of Glacier NP, at the mouth of Nyack Creek. A 170-acre polygon was mapped in the Stoner Creek

drainage in the southeast portion of the Island Unit of the Flathead NF. Thirty-nine acres of Diplodia tip blight (on State and Flathead IR lands) were mapped in the southern portion of the county along Cromwell Creek. Many smaller polygons were mapped just across the border in Lake County. This general area experienced significant hail damage in 2007, or possibly late 2006 (MFO-TR-08-07), likely providing entry courts for the fungus responsible for Diplodia tip blight. Three small polygons of winter injury totaling 64 acres were mapped in the southern edge of county on the Flathead IR. These polygons are mixed in with the polygons of Diplodia tip blight damage.

White pine blister rust is common in both WWP and WBP in this county. Significant white pine blister rust was noted in WBP on the Ralph Thayer trail southwest of Red Meadows Lake Campground (MFO-TR-10-25). Root diseases are common in counties west of the Continental Divide. The more common ones known to occur in this county are: s-type annosus root disease, Armillaria root disease, and schweinitzii root and butt rot. The tree species most affected are DF and true firs. P-type annosus root disease is known to occur in PP. Annosus root disease was identified in SAF at Ashley Lake. Also present was decay in DF indicative of tomentosus root disease (MFO-TR-13). Armillaria root disease was found to be contributing to significant SAF mortality along the Coal Ridge Trail. Other factors are also likely involved in this widespread mortality (MFO-TR-10-25).

Douglas-fir dwarf mistletoe, lodgepole pine dwarf mistletoe, and western larch dwarf mistletoe are present and common in this county.

Dutch elm disease has been reported in Kalispell, Columbia Falls, and nearby communities.

Gallatin County

Acres of Forestland, Mortality, and Defoliation by Ownership (1,031,107 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	585,048	77,463	199,570	6,281	868,362
Dieback	34	0	216	50	300
DFB	1,678	255	174	0	2,107
MPB-LPP	51,872	2,497	19,599	4,868	78,836
MPB-PP	0	0	2	0	2
MPB-High Elevation	16,684	2557	1,904	11	21,156
SAF Mortality	534	0	568	0	1,102
WSBW	11,286	76	8,381	140	19,883

In 2010, insect activity continued throughout Gallatin County but was less than acreage detected in 2009. Aerial flights surveyed similar amounts of acres over this time period. MPB-caused mortality in LPP and high-elevation pines (mostly WBP) had respective 3

and 4-fold reductions in acres detected in 2010 relative to 2009. Ground surveys and FINDIT plots in LPP indicated only limited, viable MPB populations in specific areas sampled in the Bridger Mountains, Gallatin Canyon, and near Hebgen Lake (MFO-TR-10-24 and MFO-TR-10-30). MPB populations were reduced following host depletion in some areas and may have been reduced by weather-related brood mortality in other locations. Ground surveys also found that mortality occurred in numerous trees where crown discoloration (fading) occurred in late fall after aerial detection surveys were conducted. Thus, these surveys may have slightly underestimated 2010 MPB-caused tree mortality in some areas.

Acres with WSBW-caused DF defoliation (which increased 7-fold in 2009 over 2008) decreased 13-fold from $\approx 261,000$ acres detected in 2009. Consecutive years of widespread WSBW defoliation has directly resulted in sporadic instances of DF mortality and has contributed to physiological stress that could promote increased DFB activity in subsequent years. DFB activity remained relatively constant at low levels from 2009 to 2010 with mortality detected primarily on Gallatin NF lands west of Hebgen Lake in the Madison Mountains.

Approximately 5 acres of ponderosa pine were defoliated in the Gallatin Gateway by pine sawfly, *Neodiprion nannulus contortae* Ross.

Tomentosus root disease is known to be significant in some campgrounds in this county, mostly affecting ES. Samples were collected from Fairy Lake, Battleridge, and Red Cliff campgrounds in 2010 for a small study of tomentosus root disease in eastern Montana. Schweinitzii root and butt rot and tomentosus root disease were found to be causing butt decay in ES, DF, and SAF and contributing to wind throw at Bridger Bowl Ski area (MFO-TR-10-16) as well as at a number of campgrounds in the county (MFO-TR-10-19). *Cytospora abietis*, a common and very low level pathogen, was found to be causing dieback in small SAF (MFO-TR-10-19). Fir broom rust is common in numerous campgrounds in the county (MFO-TR-10-19). Lodgepole pine dwarf mistletoe is common, and was found at high levels near Hebgen Lake (MFO-TR-10-30). *Lachnellula arida* was found causing cankers and significant mortality of understory SAF near Hebgen Lake (MFO-TR-10-30).

White pine blister rust is common in WBP and LP. Black stain root disease has been identified from DF, but is considered of minor importance. Limber pine dwarf mistletoe is present in the county.

Glacier County

Acres of Forestland, Mortality, and Defoliation by Ownership (598,175 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	33,937	226,013	158,432	0	418,382
Dieback	0	2,388	802	0	3,190
DFB	0	192	41	0	233
Lophodermella concolor	0	1,510	27	0	1,537
MPB-LPP	605	3757	656	0	5,018
SAF Mortality	0	2,164	0	0	2,164
WSBW	0	3108	132	0	3,240

In 2010, insect activity continued throughout the western portion of Glacier County but was detected at reduced levels relative to 2009. Aerial flights surveyed similar amounts of area in these years; however, slightly more area was covered on tribal and private lands in the south-central portion of Glacier County. WSBW defoliation of DF was primarily detected in the western portion of the Blackfeet IR and in the eastern portion of Glacier NP. Acres with WSBW defoliation decreased 6-fold from $\approx 19,000$ acres detected in 2009 and acres detected with DFB and SAF mortality each decreased 3-fold from 2009 to 2010. MPB-caused LPP mortality increased as 1.5 times greater acres were detected with mortality in 2010 over 2009. Estimates for MPB-killed trees within affected acres increased from $\approx 4,900$ in 2009. Interestingly, this trend followed a drop in MPB-estimated LPP mortality from 2008 to 2009.

Over 1500 acres of lodgepole pine needlecast were mapped during the 2010 ADS. One 200-acre polygon is located in the northern portion of Glacier NP on the south side of Boundary Creek near the Canadian border. A larger 400-acre polygon plus several smaller polygons were mapped in the Kennedy Creek drainage on the east side of Glacier NP and in the neighboring Blackfeet IR. Several large polygons were also mapped in the northwest portion of the Blackfeet IR at the head of Middle Fork of Lee Creek and at the head of Roberts Creek.

White pine blister rust is common in WBP and LP. Armillaria root disease is known to be a significant pathogen in DF in the western portion of the county on the Blackfeet IR. Lodgepole pine dwarf mistletoe and western larch dwarf mistletoe are present in this county.

Golden Valley County

Acres of Forestland, Mortality, and Defoliation by Ownership (2,633 acres surveyed)

No damage was detected by aerial detection surveys within Golden Valley County during 2010.

Granite County

Acres of Forestland, Mortality, and Defoliation by Ownership (393,854 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	585,795	26,809	190,740	42,302	845,646
DFB	57	10	33	5	105
MPB-LPP	65,206	5,258	13,591	730	84,785
MPB-PP	1,229	361	1,210	73	2,873
MPB-High Elevation	8,785	0	861	0	9,646
SAF Mortality	363	0	32	0	395
WSBW	1,879	2,317	4,055	509	8,760

About 1/3 of the county surveyed in 2009 was not resurveyed in 2010, resulting in the apparent decrease in activity of most insect pests. However, information on the numbers of trees killed by MPB shows an increase in the intensity of mortality detected in 2010. Three ground plots (FINDIT) around Georgetown Lake and one near Garnett Ghost Town suggest MPB activity spiked in 2009 (trees fading in 2010) with 2010 activity (green trees with current attack) dropping markedly. Although cool, wet weather favored tree survival, the noted drop in activity is most likely due to host depletion. Although mortality in PP remained around 3 TPA, estimates more than doubled in LPP and 5-needle pine (WBP); increasing from 4.3 to 10, and from 2.1 to 5.7 TPA, respectively. Most 5-needle pine mortality occurred in the high elevations of the Flint Creek Range, expanding into host between Warm Springs and Foster Creeks.

Mortality of SAF also increased in intensity although less area was mapped. A drop in DFB activity was observed due to decreased survey area in host type. WSBW defoliation greatly decreased; however, this appears due principally to the lack of survey in much of the host type. In areas surveyed both years, WSBW defoliation continued at high levels (Garnet Range) or greatly increased (notably in the Long Mountains and near East Fork Reservoir).

Root diseases are common in counties west of the Continental Divide. The more common ones known to occur in this county are: s-type annosus root disease, armillaria root disease, and schweinitzii root and butt rot. The tree species most affected are DF and true firs. P-type annosus root disease is known to occur in PP. Elytroderma needle disease is a significant agent in PP in localized areas in this county. Lodgepole pine dwarf mistletoe and western larch dwarf mistletoe are present in this county.

Hill County

Acres of Forestland, Mortality, and Defoliation by Ownership (63,954 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	0	0	35,016	0	35,016
MPB-LPP	0	3,168	994	37	4,199
MPB-PP	0	282	126	4	412
WSBW	0	99	1	0	100

WSBW activity significantly decreased on forested lands in the county. Defoliation from WSBW was only detected on 100 acres in 2010 as compared to 4,556 acres in 2009. Number of acres of MPB-killed LPP did not increase in 2010. Number of MPB-killed LPP, or the intensity, decreased by almost 4-fold in the county. MPB-killed PP increased from 69 to 412 acres from 2009 to 2010.

Armillaria root disease is present in the southern portion of the county, on the Rocky Boys IR, but appears to be uncommon. Lodgepole pine dwarf mistletoe is present in this county.

Jefferson County

Acres of Forestland, Mortality, and Defoliation by Ownership (511,057 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	430,785	60,017	118,707	16,380	625,889
DFB	8	10	10	0	28
MPB-LPP	121,223	3,999	6,880	297	132,399
MPB-PP	9,379	6,145	25,469	1,046	42,040
MPB-High Elevation	3,718	406	391	0	4,516
WSBW	876	8	173	0	1,057

Whereas most of the county was flown in 2009, lands between Boulder and Butte were not surveyed in 2010, resulting in only about half the total area surveyed from the previous year. Nevertheless, acres of MPB activity in all hosts and DFB activity in DF showed marked decreases usually greater than what might be expected with decreased survey area. This may be due in part to depletion of host in areas where MPB has been active for many years. Nearly all PP mortality was located south of Boulder along the Interstate. Mortality in 5-needle pines was almost entirely located in the Elkhorn Mountains in both 2009 and 2010. In 2010 a small polygon was also mapped in the Three Brothers area along the Powell County border.

Some of the drop in DFB activity was due to a reduction in the areas of host type being flown in 2010. A few spots were still mapped north of Basin and Boulder. WSBW greatly decreased with only a few spots of activity noted near Basin.

White pine blister rust has been found in LP.

Judith Basin County

Acres of Forestland, Mortality, and Defoliation by Ownership (198,390 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	272,021	0	20,434	8,370	300,825
DFB	10	0	2	0	12
MPB-LPP	18,124	972	2,588	39	21,723
MPB-PP	1,741	247	1,985	11	3,984
MPB-High Elevation	1,291	0	133	15	1,439
SAF Mortality	154	0	12	0	166
WSBW	2,020	285	970	27	3,302

Less than half the area surveyed in 2009 was resurveyed in 2010 (northeast corner of Little Belts), although a sliver of the Highwood Mountains along the north border was added. Acres of bark beetle activity in all host types dropped due principally to the decrease in area surveyed. When only areas surveyed in both years are viewed, maps show a significant increase in MPB activity in LPP, some increase in activity in PP, and a decrease in activity in 5-needle pines.

DFB activity resulted in a few additional small, scattered spots of mortality. Because most areas showing SAF mortality in 2009 were resurveyed in 2010, the decrease in acres is likely indicative of actual changes. WSBW defoliation continued in survey areas although at greatly reduced area; defoliation was also noted in the Highwood Mountains.

White pine blister rust is common in LP. Tomentosus root disease is known to be significant in some campgrounds. Lodgepole pine dwarf mistletoe is present in this county.

Lake County

Acres of Forestland, Mortality, and Defoliation by Ownership (418,204 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	174,128	0	336,476	41,207	551,811
Diplodia Canker	0	860	522	125	1,507
DFB	19	0	18	2	39
ESB	4	0	0	0	4
FE	29	0	16	0	45
Flooding - High Water	2	0	2	2	6
Larch Needle Blight	50	0	0	0	50
Lophodermella concolor	112	0	0	0	112
MPB-LPP	3,011	26	589	135	3,761
MPB-PP	356	234	246	26	862
MPB-High Elevation	4	0	0	0	4
IPS	0	10	2	0	12
SAF Mortality	984	0	2	50	1,036
WPB	0	2	2	4	8
WSBW	0	166	121	0	286
Winter Injury	0	0	53	2	55

Only the northwest and northeast portions of Lake County were surveyed with aerial flights in 2010. Area surveyed varied greatly compared to 2009; thus, direct year to year comparisons are not feasible. 2010 surveys were isolated to the northwestern and northeastern portions of Lake County just northwest and east of Flathead Lake, respectively. MPB-caused PP mortality was detected in numerous, small pockets that were scattered throughout the southeastern portion of the Salish Mountains just northwest of Flathead Lake on private, Flathead IR, and Flathead NF lands. MPB-caused LPP mortality and SAF mortality were detected, often in large pockets, on the northern portion of the Mission Range. Affected areas were primarily on land managed by the Flathead NF and to a lesser extent on State and private lands.

Over 1500 acres of Diplodia tip blight were mapped on private and Flathead IR lands in the northwest portion of this county during the 2010 ADS. A few smaller polygons were also mapped just across the border in Flathead County. This general area experienced significant hail damage in 2007, or possibly late 2006 (MFO-TR-08-07), likely providing entry courts for the fungus responsible for Diplodia tip blight. Fifty acres of larch needle blight were mapped on the west side of the Mission Mountains. One 20-acre polygon is at the head of Crane Creek, and another 30-acre polygon is at the head of Parker Creek. Two areas of lodgepole pine needlecast were mapped; one 40-acre polygon along Piper Creek on the east side of the Mission Mountains, and a 70-acre polygon on the Island Unit of the Flathead NF, in the very northeast corner of the county.

White pine blister rust is common in both WWP and WBP. Root diseases are common in counties west of the Continental Divide. The more common ones known to occur in this county are: s-type annosus root disease, Armillaria root disease, and schweinitzii root and butt rot. The tree species most affected are DF and true firs. P-type annosus root disease is known to occur in PP. Elytroderma needle disease is a significant agent in PP in localized areas in this county. Douglas-fir dwarf mistletoe, lodgepole pine dwarf mistletoe, and western larch dwarf mistletoe are present in this county.

Lewis and Clark County

Acres of Forestland, Mortality, and Defoliation by Ownership (1,335,423 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	991,403	35,287	339,120	37,521	1,403,331
Dieback	56	0	11	136	203
DFB	1,438	47	186	364	2,035
MPB-LPP	161,904	3,899	28,628	5,265	199,696
MPB-PP	34,185	11,396	59,833	10,314	115,728
MPB-High Elevation	7,266	7	67	41	7,381
IPS	0	0	60	0	60
SAF Mortality	1,818	0	0	0	1,818
WSBW	18,051	1,259	14,418	2,414	36,142

Similar areas flown in 2009 were reflight in 2010, with the addition of a portion of the Bob Marshall and Gates of the Mountain Wilderness, and deletion of a portion between Flesher Pass and Canyon Creek. A decrease in acres of MPB in LPP as detected in 2010 is due largely to the decrease in survey area. The portion of Bob Marshall surveyed in 2010 shows MPB has been fairly active in LPP. Three ground plots (FINDIT) in the South Fork Sun and Willow drainages show drops in MPB activity in LPP in 2010. However, steep slopes prevent survey in much of the host type. Another three plots in the Lincoln-Rogers Pass area are representative of the 2009 peak of activity, decreasing in 2010, with little susceptible host remaining in many stands (cumulative mortalities of ~50% host type). Most areas of PP mortality were surveyed both years, and show only a slight decrease in acres affected with a slight increase in the number of trees affected. This suggests that MPB activity in PP continued in 2009 (visible in 2010) much as it did in 2008. Increased mortality of 5-needle pines appears to be due to an expansion of MPB in host around Black Mountain and newly surveyed areas of the Bob Marshall near the North Fork Sun.

DFB continues to be active along the Rocky Mountain Front. (Activity began after 2007 wildfires created sufficient quantities of scorched host material for beetle population to increase.) The large increase in SAF mortality acres is attributable to survey in the Bob Marshall along the North Fork Sun. WSBW defoliation was noted wherever host type is found with a continued concentration of activity around Rogers Pass, and some

increased activity noted north and south of Lincoln, and north of Rogers Pass along the Continental Divide.

Aspen dieback was noted along FS border with the Sun River Wildlife Management Area at the north end.

Armillaria root disease is present in the southeastern portion of the county, and schweinitzii root and butt rot is quite common, especially causing significant decay in the butt logs of larger, older DF. Armillaria root disease was noted in SAF and common juniper at Benchmark Campground (MFO-TR-10-12).

White pine blister rust is common in WBP and LP. Lodgepole pine dwarf mistletoe is present and common in this county.

Liberty County

Aerial detection surveys were not conducted in Liberty County during 2010. Ground surveys noted White pine blister rust occurring on WBP and LP. Lodgepole pine dwarf mistletoe is present in this county.

Lincoln County

Acres of Forestland, Mortality, and Defoliation by Ownership (**2,168,262 acres surveyed**)

	National Forest	Other Federal	Private	State	Total
Forestland	1,749,728	0	376,569	42,321	2,168,618
DFB	197	0	38	11	246
ESB	12	0	0	0	12
FE	42	0	0	0	42
MPB-LPP	1,913	0	884	21	2,818
MPB-PP	157	0	28	4	189
MBP_WP	8	0	8	0	16
MPB-High Elevation	6	0	0	0	6
SAF Mortality	2,258	0	8	2	2,268
WPB	8	0	4	0	12
WSBW	46,551	0	7,614	919	55,084
Windthrow	19	0	0	0	19

In 2010, most of the county was flown. Aerial detection survey showed that insect activity decreased significantly across the county. Defoliation from WSBW was recorded on 55,084 acres which is about 70% fewer acres than in 2009. Defoliation from WSBW was recorded on host trees scattered throughout the county. Acres of MPB-killed LPP and PP decreased across the county. However number of LPP killed by MPB increased in the county. Pockets of MPB-killed LPP were recorded east of

Eureka and in the south-east corner of the county on the Sanders County border. SAF mortality significantly dropped from 6,298 to 2,268 acres. DFB activity remained about the same at low and scattered levels. Endemic levels of WPB, ESB and FE were found scattered throughout the county. BWA has been confirmed near Bull Lake.

Root diseases are common in counties west of the Continental Divide. The more common ones known to occur in this county are: s-type annosus root disease, Armillaria root disease, and schweinitzii root and butt rot. The tree species most affected are DF and true firs. P-type annosus root disease is known to occur in PP.

White pine blister rust is common in both WWP and WBP. Douglas-fir dwarf mistletoe, lodgepole pine dwarf mistletoe, and western larch dwarf mistletoe are present in this county.

Madison County

Acres of Forestland, Mortality, and Defoliation by Ownership (1,204,743 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	598,215	96,634	139,715	9,272	843,836
Dieback	0	12	107	14	133
DFB	32	2	16	0	50
ESB	5,449	0	18	7	5,474
MPB-LPP	55,943	4,322	7,602	757	68,624
MPB-PP	8	0	0	0	8
MPB-High Elevation	23,382	141	2,508	49	26,080
SAF Mortality	2,440	0	4	0	2,444
WSBW	3,847	514	687	89	5,137
Windthrow	479	0	229	19	727

Nearly all the same areas were surveyed in both 2009 and 2010, thus changes in mapped activity are indicative of changes in actual pest activity. Of greatest significance was the detection of active ESB, mostly in the southern Gravelly Mountains along Standard Creek on FS managed lands. Nearly 5.5 thousand acres were detected. Ground assessment in the fall of 2010 indicated active, viable ESB populations with mortality occurring primarily in large-diameter ES trees (>20 inches diameter at breast height). Barring extreme winter weather, subsequent mortality in large-diameter host is anticipated in subsequent years.

MPB activity in all host types decreased to levels nearly half those of 2009 across all areas where it had been mapped. Ground survey (FINDIT) was limited to four islands of WBP in close proximity to each other. Results show increased MPB activity in WBP in 2010 over 2009 levels. SAF mortality was also down with small scattered patches in both the Gravelly and Tobacco Root Ranges. WSBW defoliation also decreased significantly everywhere it had been found, particularly at the north end of the Gravelly

Range. Several small polygons of aspen decline were also noted northeast of the Lee Metcalf Wilderness, extending into Gallatin Gateway in Gallatin County.

Large and small polygons of windthrow, totaling over 700 acres, were mapped during the 2010 ADS. These are all located in the Lee Metcalf Wilderness area north of Big Sky, in Willow Swamp Creek, North Fork of Spanish Creek, and at the head of St. Joe Creek. It's quite probable these all resulted from the same wind event.

White pine blister rust is common in WBP and LP. Limber pine dwarf mistletoe is present in this county.

Meagher County

Acres of Forestland, Mortality, and Defoliation by Ownership (921,266 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	454,395	0	212,692	17,536	684,623
Dieback	12	0	52	0	64
DFB	22	0	20	0	42
MPB-LPP	166,958	157	15,219	346	182,680
MPB-PP	5,550	228	20,183	1,449	27,410
MPB-High Elevation	92,410	59	1,156	34	10,459
IPS	0	0	42	0	42
SAF Mortality	64	0	0	0	64
WSBW	5,072	202	3,121	6	8,401
Windthrow	316	0	107	0	423

Perhaps 1/5th of areas surveyed in 2009 were not resurveyed in 2010, principally at the northwest and northeast corners of the county. Decreases in MPB activity in LPP are greater than that explained by the difference in survey area. When only areas surveyed both years are viewed, the decrease in activity appears as smaller polygon size rather than less activity in particular areas. Ground plots (FINDIT), all located in the Little Belt Range, suggest MPB activity in LPP may be patchy with some plots recording attacks in 2009 and prior, and other areas with 2010 and pre-2009 attacks but no 2009 activity. Whether 2009 winter weather affected populations in this region is unknown. However, susceptible host material remains that could give rise to MPB population increases in the future. Areas of 5-needle pine mortality were surveyed both years, suggesting that the ~50% drop in acres and ~75% drop in dead trees detected is representative of a drop in activity in high elevation host, likely due to a depletion of host type. Despite a decrease in survey area, acres of MPB activity in PP were similar to 2009 levels, suggesting 2010 actually saw a slight increase in mortality levels.

WSBW defoliation significantly decreased in all areas, with greatest decreases noted along the western edge of the Little Belts.

During the 2010 ADS, over 400 acres of wind throw were mapped in the Crazy Mountains. These acres are distributed at the heads of Lebo Fork and Middle Fork of Big Elk Creeks, and along Crandall Creek.

White pine blister rust occurs on LP in this county, and was found to be prevalent in WBP in the upper portions of Showdown Ski Area (MFO-TR-10-06).

Armillaria root disease is present in the county, and schweinitzii root and butt rot is quite common, especially causing significant decay in the butt logs of larger, older DF. Tomentosus root disease is known to be significant in some campgrounds in this county, mostly affecting ES. Samples were collected from Grasshopper campground in 2010 for a small study of tomentosus root disease in eastern Montana.

Significant top kill in LPP was noted at Showdown Ski Area and was attributed to comandra blister rust (MFO-TR-10-06). Lodgepole pine dwarf mistletoe is present and common in this county.

Mineral County

Acres of Forestland, Mortality, and Defoliation by Ownership (**132,804 acres surveyed**)

	National Forest	Other Federal	Private	State	Total
Forestland	637,014	0	80,646	17,948	735,608
DFB	10	0	0	0	10
MPB-LPP	1,067	0	4		1,072
MPB-PP	290	0	21	8	319
MPB-High Elevation	4	0	0	0	4
SAF Mortality	6	0	0	0	6
WPB	2	0	0	0	2
WSBW	2,478		242	128	2,849

Only a small portion of Mineral County was surveyed with aerial flights in 2010. Area surveyed varied greatly compared to 2009; thus, direct year to year comparisons are not feasible. 2010 surveys were isolated to a small area near Superior on lands managed by the Lolo NF. Insect activity detected in this area included small, isolated pockets of MPB-caused mortality in LPP and PP hosts and widespread WSBW defoliation of DF. BWA has been confirmed near Missoula Lake, northwest of St. Regis, and near the Idaho State line.

White pine blister rust is common in both WWP and WBP. Root diseases are common in counties west of the Continental Divide. The more common ones known to occur in this county are: s-type annosus root disease, armillaria root disease, laminated root disease, and schweinitzii root and butt rot. The tree species most affected are DF and true firs. P-type annosus root disease is known to occur in PP. Douglas-fir dwarf mistletoe, lodgepole pine dwarf mistletoe, and western larch dwarf mistletoe are present in this county.

Western larch dwarf mistletoe, Armillaria root disease and tomentosus root disease were found contributing to the significant decline of WL in several areas along Montana State Highway 135 between St. Regis and Paradise (MFO-TR-10-14).

Missoula County

Acres of Forestland, Mortality, and Defoliation by Ownership (1,071,592 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	673,763	17,621	571,755	133,415	1,396,554
DFB	220	0	10	6	236
ESB	0	0	2	0	2
FE	6	0	8	0	14
Larch Needle Blight	0	0	22	0	22
MPB-LPP	36,893	2306	11,298	6,736	57,233
MPB-PP	1,357	170	9,967	7,728	19,222
MPB-High Elevation	267	0	0	0	267
IPS	6	0	16	0	22
SAF Mortality	404	0	6	0	410
WPB	14	0	14	4	32
WSBW	0	905	2,237	1,707	4,847

Acres of trees killed or affected by all insects significantly decreased across the county. Once again, MPB was the most significant insect agent in the county. Only number of acres of MPB-killed high elevation pines increased and almost doubled in 2010. Large groups of MPB-killed LPP and PP were recorded again near Missoula and east to Greenough. Large groups of MPB-killed LPP were also mapped along Lolo Creek and the Highway 83 corridor. DFB activity decreased significantly across the county with only 236 acres affected. There were minor amounts of SAF mortality recorded. Defoliation from WSBW significantly decreased from 17,144 in 2009 to 4,847 acres in 2010. Endemic levels of other bark beetles were found scattered throughout the county.

During the 2010 ADS, two small polygons of larch needle blight, totaling 22 acres, were mapped northwest of Missoula at head of Bear Creek, a feeder stream of Mill Creek.

White pine blister rust is common in both WWP and WBP. Root diseases are common in counties west of the Continental Divide. The more common ones known to occur in this county are: s-type annosus root disease, Armillaria root disease, laminated root disease, and schweinitzii root and butt rot. The tree species most affected are DF and true firs. P-type annosus root disease is known to occur in PP. Elytroderma needle disease is a significant agent in PP in localized areas in this county. Douglas-fir dwarf mistletoe, lodgepole pine dwarf mistletoe, and western larch dwarf mistletoe are present in this county.

Park County

Acres of Forestland, Mortality, and Defoliation by Ownership (805,846 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	736,420	70,512	178,181	32,732	1,017,845
MPB-High Elevation	11,706	6238	4,240	11	22,195
SAF Mortality	93	2	237	0	332
Unidentified Defoliator	0	0	57	0	57
WSBW	6,291	2505	10,391	205	19,392
Windthrow	1	0	172	0	173

In 2010, insect activity continued throughout Park County but was detected at reduced rates for most pests relative to 2009. These reductions in insect activity were similar to those detected in adjacent Gallatin County. Aerial flights surveyed similar amounts of acres in 2009 and 2010. Observed insect-caused damage primarily occurred on private and Gallatin NF lands and was often detected in similar areas documented in 2009. MPB activity was detected on substantially fewer acres for LPP and high-elevation pine (mostly WBP) hosts. Acres of LPP and high-elevation pines were reduced 3-fold from \approx 140,000 acres detected in 2009 while acres of high-elevation pines detected were reduced 4-fold from approximately 83,000 acres.

WSBW defoliation decreased 6-fold from the approximately 117,000 acres detected in 2009. Consecutive years of widespread WSBW defoliation has directly resulted in sporadic instances of DF mortality and has contributed to physiological stress that could promote increased DFB activity in subsequent years. DFB populations remained endemic throughout most of the DF host type in Park County; however, DFB-caused mortality increased in private and Gallatin NF lands in the eastern portion of the Absaroka Mountains and a few other isolated locations. Surveys detected a 2-fold increase in 2010 DFB activity over the approximately 624 acres detected in 2009. SAF mortality had a 26-fold reduction from approximately 8,700 acres detected in 2009.

A 173-acre polygon of wind throw was mapped in the Crazy Mountains along the Shields River during the 2010 ADS.

White pine blister rust is common in WBP and LP. Tomentosus root disease is known to be significant in some campgrounds in this county. Lodgepole pine dwarf mistletoe is present.

Phillips County

Acres of Forestland, Mortality, and Defoliation by Ownership (**76,662 acres surveyed**)

	National Forest	Other Federal	Private	State	Total
Forestland	0	95,821	49,563	0	145,384
MPB-LPP	0	88	6	2	96
MPB-PP	0	133	36	12	181

Low and scattered levels of MPB-killed LPP and PP were found throughout the county. Although number of acres affected by MPB decreased, the intensity or TPA killed by MPB increased. Aerial survey did not detect any WSBW-caused tree defoliation in the county.

Lodgepole pine dwarf mistletoe is present in this county.

Pondera County

Acres of Forestland, Mortality, and Defoliation by Ownership (**187,961 acres surveyed**)

	National Forest	Other Federal	Private	State	Total
Forestland	92,477	0	8,602	0	101,079
Dieback	0	1,936	749	16	2,701
DFB	24	2	3	1	30
Flooding - High Water	11	0	0	0	11
MPB-LPP	4,687	1,004	132	570	6,393
MPB-High Elevation	45	13	44	3	105
SAF Mortality	1,245	6	0	0	1,251
WSBW	2	122	0	0	124

Only the west end of the county was flown with about half again as many acres surveyed in 2010, largely on private lands. A 2.5-fold increase in area affected by MPB and over a 4.5-fold increase in the number of trees estimated killed were detected. On FS lands alone where similar areas were surveyed in both years, acres affected doubled while estimated trees killed quadrupled. MPB activity noted in 5-needle pines is largely in LP, with scattered patches of mortality across all ownerships along the foothills. Although overall activity decreased, possibly due to host depletion, new mortality was mapped in areas not surveyed in 2009. DFB activity remained low with SAF mortality declining to under half of what it was in 2009. Defoliation by WSBW of sufficient severity to map decreased in 2010, although a new area along Birch Creek was mapped and a 122 acre polygon on Tribal land near the border with Glacier County was noted in an area not surveyed in 2009.

One 11-acre polygon of flood damage was mapped on Haywood Creek, just west of Birch Creek Reservoir during the 2010 ADS.

White pine blister rust is common in WBP and LP.

Powell County

Acres of Forestland, Mortality, and Defoliation by Ownership (1,092,343 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	617,274	70,663	251,596	29,711	969,244
Dieback	0	0	66	0	66
DFB	223	8	8	12	251
ESB	4	0	0	0	4
MPB-LPP	131,838	42,632	20,535	3,102	198,107
MPB-PP	2,082	3,951	11,463	1,766	19,262
MPB-High Elevation	2,813	0	47	0	2,860
IPS	2	0	2	0	4
SAF Mortality	558	2	0	0	560
WPB	0	0	6	0	6
WSBW	3,721	161	5,119	905	9,906

Compared to the 2009 survey, approximately 1/5th less area was flown in 2010 (mostly parts of the Garnet Range and east side of Deer Lodge, as well as the wilderness was not flown). MPB-killed LPP was recorded on approximately 1.98 million acres in 2010 as compared to approximately 2.8 million acres in 2009. Although number of acres of MPB-killed PP and high elevation pines decreased, the intensity or number of TPA killed increased. Large groups of MPB-killed LPP were recorded in the Garnet Range, along the Continental Divide and northeast of Seeley Lake. Large groups of MPB-killed high elevation pines were found near Mt. Powell. Aerial detection also recorded an increase in acres of SAF mortality. WSBW caused defoliation significantly decreased across most of the county. Endemic levels of DFB, WPB and IPS were lightly scattered across the county.

Root diseases are common in counties west of the Continental Divide. The more common ones known to occur in this county are: s-type annosus root disease, Armillaria root disease, and schweinitzii root and butt rot. The tree species most affected are DF and true firs. P-type annosus root disease is known to occur in PP. Significant schweinitzii root and butt rot was responsible for a DF tree failure at the Monture Campground. Armillaria root disease was found to be significant in DF and SAF in the Big Nelson Campground (MFO-TR-10-31). Stem decay was also noteworthy in Monture Campground, including Indian paint fungus in SAF, red belt fungus in ES, and red ring rot in WL (MFO-TR-10-31).

White pine blister rust is common in WBP and LP. Lodgepole pine dwarf mistletoe is present in this county.

Ravalli County

Acres of Forestland, Mortality, and Defoliation by Ownership (1,185,692 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	1,063,159	0	136,936	25,844	1,225,939
DFB	1,247	0	90	6	1,343
ESB	2	0	0	0	2
MPB-LPP	68,903	0	829	542	70,274
MPB_PP	1,648	0	468	402	2,518
MPB-High Elevation	2,651	0	6	0	2,657
IPS	2	0	0	0	2
SAF Mortality	2,117	0	7	0	2,124
WPB	8	0	10	2	20
WSBW	109	0	171	109	389

In 2010, MPB was the most significant and common bark beetle in the county. MPB activity increased across the county exponentially and was detected in many areas in 2010 where no activity was recorded in 2009. The majority of MPB-killed trees were in the southern portion of the county, south of Highway 38. MPB activity (acres and numbers) also increased in PP. Both large and smaller ponderosa pines were attacked and killed. Number of acres of high elevation pines affected by MPB remained about the same but the TPA or intensity of activity increased at most sites. DFB mortality significantly increased in Ravalli County. Number of trees per acre killed by DFB increased 8-fold and number of acres impacted by DFB increased 5 fold in 2010. SAF mortality was recorded on significantly fewer acres in 2010 but the intensity or TPA increased by about 2-fold. Other bark beetle-caused mortality was recorded at endemic levels. WSBW activity decreased by about 5-fold probably in response to the improvement in moisture conditions in 2010.

WSBW and pine butterfly have reportedly increased in the county although not necessarily picked up by aerial detection. BWA has been confirmed east of Stevensville near Ambrose Saddle.

Seven sets of FINDIT plots were established in the Cameron Blue project (West Fork Ranger District). Results of plots showed that MPB is at low and scattered levels throughout the project area. Most of the MPB-caused tree mortality occurred in 2010 and a limited number of trees were attacked in 2009.

White pine blister rust is common in WBP. Root diseases are common in counties west of the Continental Divide. The more common ones known to occur in this county are: s-type annosus root disease, Armillaria root disease, laminated root disease, and schweinitzii root and butt rot. The tree species most affected are DF and true firs. P-type annosus root disease is known to occur in PP in the foothills of both the Bitterroot and Sapphire Mountains.

Elytroderma needle disease is a significant agent in PP in localized areas in this county. High levels were noted in the area around Lake Como (MFO-TR-10-07). Relatively high levels of comandra blister rust causing top kill in PP were noted in the foothills of the Bitterroot Mountains (MFO-TR-10-07; MFO-TR-10-29).

Douglas-fir dwarf mistletoe, lodgepole pine dwarf mistletoe, and western larch dwarf mistletoe are present in this county, with Douglas-fir dwarf mistletoe being quite common in the lower elevations of the Sapphire and Bitterroot Mountains.

Sanders County

Acres of Forestland, Mortality, and Defoliation by Ownership (**866,377 acres surveyed**)

	National Forest	Other Federal	Private	State	Total
Forestland	899,309	9,005	447,326	62,199	1,417,838
Diplodia Canker	0	26	2	0	28
DFB	120	6	33	4	163
FE	18	2	43	2	65
Flooding - High Water	2	0	15	0	17
LCB	0	117	0	0	117
LNC	0	24	0	0	24
MPB-LPP	10,919	1,714	1,927	734	15,294
MPB-PP	386	471	428	98	1,383
MPB-High Elevation	2	0	4	0	6
IPS	0	47	6	0	52
SAF Mortality	18	6	0	4	28
Unidentified Defoliator	0	30	0	0	30
WPB	8	14	4	2	28
WSBW	12,827	29	4,860	1,515	19,231

Significantly fewer acres were flown in 2010 which may contribute to the decrease recorded in MPB activity in the county. The western part of the county was not flown which contained the largest groups of MPB-killed pines in 2009. Despite a reduction in acres flown, more MPB-killed PP was recorded. Many groups of MPB-killed LPP were recorded east of Trout Creek near the county border. WSBW activity significantly decreased in some parts of the county.

Several small polygons of Diplodia tip blight were mapped in the county during the 2010 ADS. Twelve acres in Camas Creek on the Flathead IR, and eleven acres southwest of Polson near the border with Lake County. Several small polygons of flood damage were mapped in the Little Thompson River drainage. A 12-acre polygon is on private land in the main drainage and two acres are on Lower Little Thompson at confluence with North Fork of Little Thompson River. One 24-acre polygon of larch needle cast

was mapped in the Valley Creek drainage on the Flathead IR. BWA has been confirmed near Combest and Cougar Peaks.

Root diseases are common in counties west of the Continental Divide. The more common ones known to occur in this county are: s-type annosus root disease, Armillaria root disease, laminated root disease, and schweinitzii root and butt rot. The tree species most affected are DF and true firs. P-type annosus root disease is known to occur in PP. Tomentosus root disease is known to occur in localized areas in the county, affecting LPP, DF and ES. Armillaria root disease and laminated root disease were found to be significant agents of decline in the Spring Gulch area and the Pilgrim Analysis Area on the west side of Noxon Reservoir, affecting DF of all ages (MFO-TR-10-15; MFO-TR-10-20). Armillaria root disease was found to be the primary agent of concern in the Antimony Project area west of Thompson Falls, affecting mostly DF (MFO-TR-10-21).

Western larch dwarf mistletoe, Armillaria root disease and tomentosus root disease were found contributing to the significant decline of WL in several areas along Montana State Highway 135 between St. Regis and Paradise (MFO-TR-10-14).

White pine blister rust is common in both WWP and WBP. Elytroderma needle disease is a significant agent in PP in localized areas in this county. Douglas-fir dwarf mistletoe, lodgepole pine dwarf mistletoe, and western larch dwarf mistletoe are present and common in this county.

Silver Bow County

Acres of Forestland, Mortality, and Defoliation by Ownership (**265,109 acres surveyed**)

	National Forest	Other Federal	Private	State	Total
Forestland	181,515	20,857	50,180	3,486	256,038
DFB	30	0	17	4	51
MPB-LPP	35,556	2,355	1,853	2,130	41,894
MPB_PP	2	0	2	0	4
MPB-High Elevation	1,435	0	0	64	1,499
WSBW	4,255	1,216	1,934	871	8,276

The same portions of forested lands south (Highland Mountains) and north (Browns Gulch) of Butte were flown in 2009 and 2010, but only 1/3 of the Fleecer Mountains within the county were flown (the NE 1/3). MPB activity in LPP decreased to approximately 1/3 the acres and 1/6 the trees, not all of which is explained by the decrease in survey area. Activity south of Butte showed a significant drop in activity, due in large part to depletion of suitable host. MPB in 5-needle pines show a significant decline. However, this is largely due to lack of survey in 2010 of areas in the Fleecer Mountains where mortality of 5-needle pine was high the previous year. Activity continues along the border with Madison County around Table Mountain

Although still at low levels, DFB activity increased, with many small polygons newly mapped along the eastern edge of the Fleecer Mountains. Previous spots along the west edge of the Highland Mountains were not noted in 2010. WSBW defoliation continued at high levels along the northeast end of the Fleecer Mountains and southwest end of the Highland Mountains. Although some activity was again noted north of Butte, levels were significantly lower.

White pine blister rust is common in WBP and LP.

Stillwater County

Aerial detection surveys were not conducted in Stillwater County during 2010. Ground surveys noted white pine blister rust has been found in WBP and LP.

Sweet Grass County

Acres of Forestland, Mortality, and Defoliation by Ownership (**165,994 acres surveyed**)

	National Forest	Other Federal	Private	State	Total
Forestland	246,540	13,228	146,449	0	406,217
DFB	2,056	140	79	4	2,279
MPB-LPP	3,306	0	2,670	0	5,976
MPB-High Elevation	1,704	0	8	0	1,712
SAF Mortality	33	0	0	0	33
Unidentified Defoliator	136	0	0	0	136
WSBW	5,722	736	7,006	315	13,779

In 2010, insect activity continued in Sweet Grass County with MPB and WSBW being the most conspicuous pests detected. Aerial surveys covered significantly less area in the county compared to area covered in 2009; thus, direct year to year comparisons of insect activity are not feasible. MPB-caused LPP mortality was primarily detected on private and Gallatin NF lands in similar locations as in 2009 in the eastern slope of the southern Crazy Mountains. MPB activity in high elevation white pines, DFB activity, and WSBW defoliation all continued within Gallatin NF lands near Boulder River in the Beartooth Mountains. SAF mortality caused by WBBB and other damage agents was detected on very few acres in 2010 including multiple areas where mortality was detected in 2009.

White pine blister rust has been found in WBP and LP.

Teton County

Acres of Forestland, Mortality, and Defoliation by Ownership (357,832 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	215,600	9,427	17,446	9,427	251,900
Dieback	0	0	29		29
DFB	1,454	198	119	18	1,789
MPB-LPP	18,836	558	1,035	951	21,380
MPB-High Elevation	3,998	76	174	32	4,280
SAF Mortality	573	2	0	0	575

Wilderness areas within Teton County not normally flown, were surveyed in 2010 resulting in nearly 50% more area covered than in 2009. MPB in LPP continued in many of the same areas, scattered throughout FS land and into bordering lands of other ownerships. The 1.5-fold increase in acres affected likely reflects the increase in acres surveyed. However, estimates of the number of trees killed suggest some decrease in overall activity. Ground plots (FINDIT) in LPP along the Teton River also suggest MPB activity may have decreased. MPB activity within 5-needle pine stands (WBP and LP) also increased in accordance with increased survey area, with a decrease in estimated intensity from 4.4 TPA killed in 2009 to 3.6 TPA in 2010.

DFB activity continued to decline in 2010, with 3/4 the acres and 1/3 the number of trees recorded compared to 2009 levels. Of note were scattered spots in the newly surveyed wilderness, and increased activity in the vicinity of North Fork Teton River. Acres of SAF mortality increase, largely due to activity noted in wilderness. Increased activity from 2009 levels, however, was noted at the headwaters of Waldron Creek, just outside wilderness. No WSBW activity of sufficient intensity to map was noted in 2010.

White pine blister rust is common in WBP and LP.

Toole County

Aerial detection surveys were not conducted in Toole County during 2010. Ground surveys noted White pine blister rust has been found in WBP and LP.

Wheatland County

Acres of Forestland, Mortality, and Defoliation by Ownership (17,815 acres surveyed)

	National Forest	Other Federal	Private	State	Total
Forestland	53,771	0	22,404	0	76,175
Dieback	0	0	13	0	13
DFB	1	0	3	0	4
MPB-LPP	930	0	232	0	1,162
MPB-PP	0	0	188	2	190
MPB - High Elevation	2	0	0	0	2
WSBW	62	0	308	22	392

None of the Little Belts within Wheatland County were flown so 2010 survey information is limited to the small portion of the Crazy Mountains at the southwest corner of the county and a sliver of the Snowy Mountains at the northeast corner. Drops in detected MPB activity are due largely to the differences in survey area. MPB remains active in LPP on FS lands in the Crazy Mountains. Some PP mortality was also noted along the Snowy Mountains. The large polygon of 5-needle pine mortality (likely LP) noted in 2009 along the northern FS border in the Crazy Mountains near the Meagher border was not detected in 2010.

A patch of aspen decline was noted in the Crazy Mountains north of Willow Creek on private lands.

White pine blister rust has been found in LP.

Yellowstone County

Aerial detection surveys were not conducted in Yellowstone County during 2010. Ground surveys noted MPB activity has reportedly decreased in community trees in the City of Billings.

2010 MPB Population Ground Survey using Forest Insect and Disease Tally (FINDIT) Plot Clusters

Ground data were obtained in 2010 to survey MPB population trends from 2009 to 2010 using FINDIT survey protocols (Bentz, 2000). Plots were established in clusters located in areas of interest where MPB-caused LPP mortality appeared to increase based on 2009 and 2010 aerial survey flights (Figure 1). Plot clusters typically incorporated 10 variable-radius plots that were spatially segregated by $\approx 120\text{-}180$ feet and distributed along a linear transect that spanned $\approx 1/4^{\text{th}}$ mile. Diameter and beetle-attack status data were collected on all trees within each plot. The primary variables of interest were quantifications of red trees attacked in 2009 (determined by characteristic crown discoloration and fine needle/branch retention) and green trees successfully attacked in 2010 (determined by inner-bark surveys for successful MPB brood colonization). Data obtained from plots were averaged to a plot cluster level and are reported in Table 1. A ratio of 2010 green-attacked / 2009 red-attacked trees (G:R) was computed for each plot cluster as a proxy for MPB populations to represent 2010 populations relative to 2009 (Wulder et al., 2006). These plot cluster data are only spatially representative of the site-specific area in which plots were established and should not be extrapolated to greater drainage, watershed, or mountain range spatial extents.

In total, 79 plot clusters were established with 816 plots surveyed in primarily LPP host type during 2010. 61 plots clusters (77% of total) had G:R ratios that indicated decreasing MPB populations from 2009 to 2010. Of these plots clusters, 30 did not detect any 2010 green-attacked trees within plots surveyed. 18 plot clusters (23% of total) had G:R ratios that indicated increasing MPB populations from 2009 to 2010. Of these plot clusters, G:R ratios typically indicated 3-7 green trees attacked in 2010 for every red tree attacked in 2009. A few plot clusters indicated G:R ratios of 12-15 : 1.

Works cited

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Figure 1. FINDIT Plot Clusters Depicting Rate of Mountain Pine Beetle-Attacked Trees in 2010 Relative to 2009

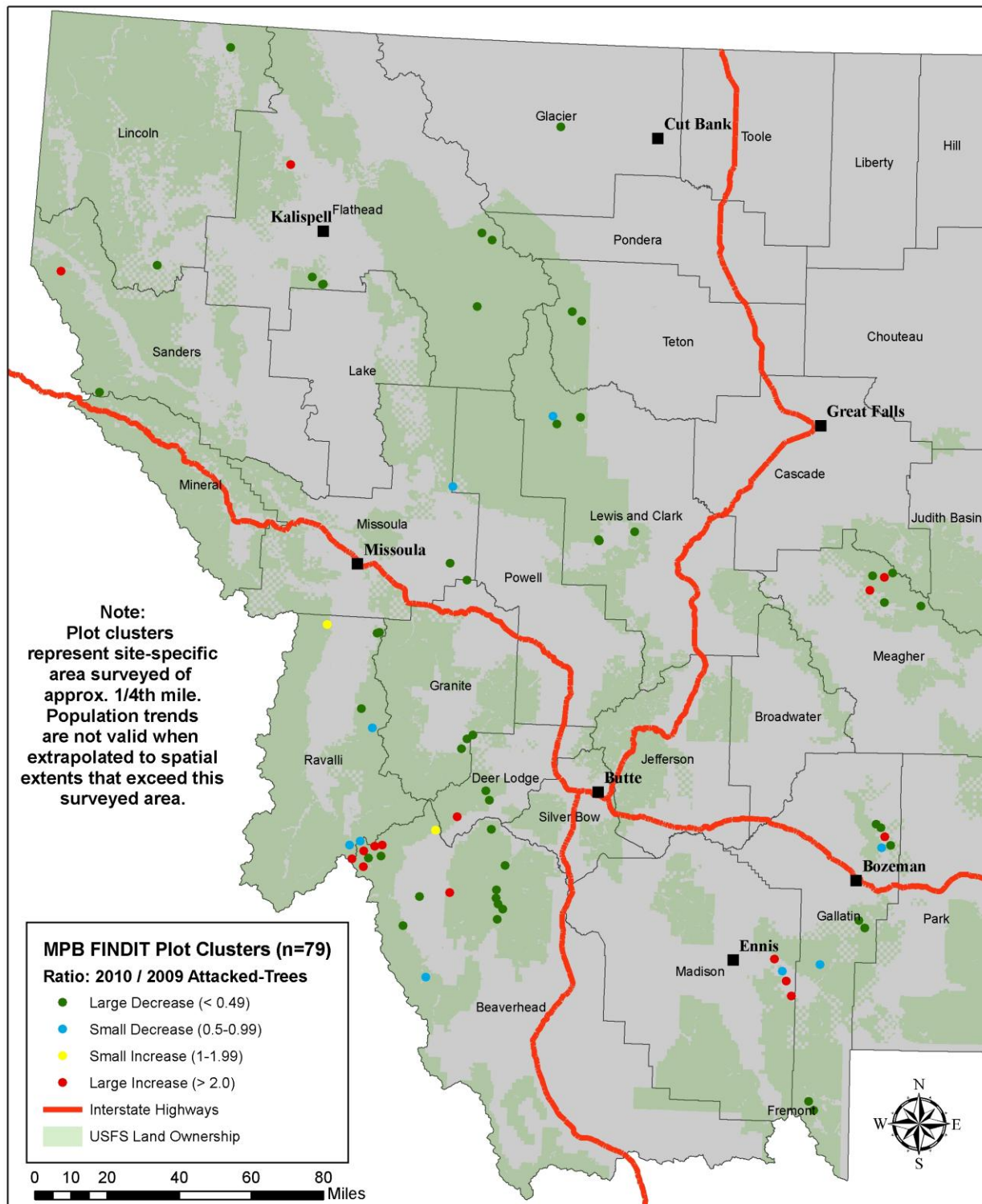


Table 1. Stand Conditions and Mortality Rates Detected within Mountain Pine Beetle FINDIT Plot Clusters Established during 2010

County	Host Type	Plots in Cluster	Pre-Outbreak Basal Area (feet² acre⁻¹)	Pre-Outbreak Stem Density (trees acre⁻¹)	Unattacked Host (trees acre⁻¹)	2010 MPB-caused Mortality (trees acre⁻¹)	2009 MPB-caused Mortality (trees acre⁻¹)	Pre-2009 MPB-caused Mortality (trees acre⁻¹)	Cumulative Mortality (% of pre-outbreak host)	Green : Red Attack Ratio
Beaverhead*	LPP	10	123	313	267	2	20	2	8%	0.1
Beaverhead*	LPP	10	129	324	289	4	10	2	5%	0.4
Beaverhead*	LPP	10	124	197	133	5	40	7	26%	0.1
Beaverhead*	LPP	10	148	323	199	21	69	3	29%	0.3
Beaverhead*	LPP	10	133	416	349	1	43	2	11%	0.0
Beaverhead*	LPP	10	157	399	180	2	62	91	39%	0.0
Beaverhead	LPP	10	138	272	154	5	12	49	24%	0.4
Beaverhead	LPP	10	171	312	233	23	17	16	18%	1.4
Beaverhead	LPP	52	109	416	381	5	11	6	5%	0.5
Beaverhead	LPP	10	112	208	138	16	8	2	13%	2.1
Beaverhead	LPP	10	130	285	226	3	7	24	12%	0.5
Beaverhead	LPP	10	134	208	187	6	7	1	6%	0.9
Beaverhead**	LPP	19	108	257	226	12	6	2	7%	2.0
Beaverhead**	LPP	13	92	182	167	3	4	2	5%	0.7
Beaverhead**	LPP	10	128	325	269	24	0	0	7%	23.0
Beaverhead**	LPP	11	120	276	225	16	0	0	6%	16.0
Beaverhead**	LPP	14	121	273	245	14	2	4	7%	5.7
Beaverhead**	LPP	8	145	177	164	2	3	5	5%	0.8
Beaverhead**	LPP	7	134	234	193	42	0	0	18%	41.0
Beaverhead**	LPP	3	180	353	202	0	81	0	23%	0.0
Blaine	LPP	5	196	484	400	0	48	0	10%	0.0
Deer Lodge	LPP	8	193	471	336	0	30	74	22%	0.0
Deer Lodge	LPP	11	205	619	578	0	6	14	3%	0.0
Deer Lodge	LPP	9	148	367	274	52	3	13	18%	15.4

County	Host Type	Plots in Cluster	Pre-Outbreak Basal Area (feet ² acre ⁻¹)	Pre-Outbreak Stem Density (trees acre ⁻¹)	Unattacked Host (trees acre ⁻¹)	2010 MPB-caused Mortality (trees acre ⁻¹)	2009 MPB-caused Mortality (trees acre ⁻¹)	Pre-2009 MPB-caused Mortality (trees acre ⁻¹)	Cumulative Mortality (% of pre-outbreak host)	Green : Red Attack Ratio
Flathead	LPP	9	144	305	222	0	0	69	23%	0.0
Flathead	LPP	10	124	230	208	0	2	16	8%	0.0
Flathead	LPP	6	107	224	179	28	8	0	16%	3.4
Flathead	LPP	10	152	491	350	27	66	17	23%	0.4
Flathead	LPP	10	134	466	434	0	6	4	2%	0.0
Flathead	LPP	6	147	146	66	0	31	23	33%	0.0
Flathead	LPP	5	204	388	221	0	12	4	4%	0.0
Gallatin	LPP	10	91	248	223	0	18	0	7%	0.0
Gallatin	LPP	10	107	240	157	16	55	3	30%	0.3
Gallatin	LPP	10	246	546	416	0	18	44	9%	0.0
Gallatin	LPP	5	124	369	145	0	102	57	43%	0.0
Gallatin	LPP	10	122	156	127	6	10	7	14%	0.6
Gallatin	LPP	5	76	181	106	15	0	19	19%	15.0
Gallatin	LPP	5	140	273	143	14	37	5	21%	0.4
Gallatin	LPP	5	132	305	179	11	46	46	34%	0.2
Gallatin	LPP	10	136	254	185	0	13	14	11%	0.0
Gallatin	LPP	10	118	210	175	0	0	26	12%	0.0
Gallatin	LPP	5	128	193	143	0	21	30	26%	0.0
Gallatin	LPP	5	236	276	219	0	29	25	42%	0.0
Gallatin	LPP	5	156	114	50	17	19	4	35%	0.9
Glacier	LPP	5	256	240	153	0	44	13	24%	0.0
Granite	LPP	10	166	271	78	4	95	44	53%	0.0
Granite	LPP	11	134	421	285	0	80	16	23%	0.0
Granite	LPP	10	131	179	126	0	25	11	20%	0.0
Granite	LPP	10	191	416	120	0	94	114	50%	0.0

County	Host Type	Plots in Cluster	Pre-Outbreak Basal Area (feet ² acre ⁻¹)	Pre-Outbreak Stem Density (trees acre ⁻¹)	Unattacked Host (trees acre ⁻¹)	2010 MPB-caused Mortality (trees acre ⁻¹)	2009 MPB-caused Mortality (trees acre ⁻¹)	Pre-2009 MPB-caused Mortality (trees acre ⁻¹)	Cumulative Mortality (% of pre-outbreak host)	Green : Red Attack Ratio
Lewis & Clark*	LPP	10	158	208	134	10	12	17	19%	0.8
Lewis & Clark*	LPP	10	213	242	112	2	74	26	42%	0.0
Lewis & Clark*	LPP	11	212	426	331	6	12	25	10%	0.5
Lewis & Clark	LPP	10	119	330	95	17	122	19	48%	0.1
Lewis & Clark	LPP	10	148	202	55	0	90	28	59%	0.0
Lewis & Clark	LPP	10	218	411	140	0	160	47	51%	0.0
Lincoln	LPP	6	140	240	124	64	10	19	39%	6.1
Lincoln	PP	12	153	239	225	0	3	0	1%	0.0
Lincoln	PP	5	164	0	0	0	0	0	0%	0.0
Madison	WBP	25	169	287	172	40	10	26	26%	3.9
Madison	WBP	20	156	295	149	80	11	1	31%	7.3
Madison	WBP	15	227	449	186	56	103	57	48%	0.5
Madison	WBP	30	217	426	252	43	14	52	26%	3.2
Meagher	LPP	10	176	202	104	0	43	38	40%	0.0
Meagher	LPP	10	88	333	173	0	25	30	16%	0.0
Meagher	LPP	5	220	433	359	7	50	2	14%	0.1
Meagher	LPP	10	250	573	474	13	0	12	4%	12.7
Meagher	LPP	10	96	231	174	3	0	5	3%	2.6
Meagher	LPP	10	118	322	217	0	24	22	15%	0.0

County	Host Type	Plots in Cluster	Pre-Outbreak Basal Area (feet ² acre ⁻¹)	Pre-Outbreak Stem Density (trees acre ⁻¹)	Unattacked Host (trees acre ⁻¹)	2010 MPB-caused Mortality (trees acre ⁻¹)	2009 MPB-caused Mortality (trees acre ⁻¹)	Pre-2009 MPB-caused Mortality (trees acre ⁻¹)	Cumulative Mortality (% of pre-outbreak host)	Green : Red Attack Ratio
Missoula	PP	11	126	146	74	17	41	13	49%	0.4
Missoula	LPP	10	148	374	249	0	42	71	30%	0.0
Missoula	LPP	10	144	284	100	55	56	26	49%	1.0
Ravalli	LPP&PP	11	74	69	21	2	20	20	60%	0.1
Ravalli	LPP	10	140	217	79	4	21	96	56%	0.2
Ravalli	LPP	5	122	76	8	8	8	50	86%	1.0
Ravalli	LPP	10	194	33	5	0	3	18	63%	0.0
Ravalli	LPP	10	174	210	61	35	24	23	40%	1.4
Ravalli	LPP	10	124	198	139	2	15	0	9%	0.1
Teton	LPP	13	128	242	178	5	16	21	17%	0.3
Teton	LPP	10	147	216	86	0	61	29	42%	0.0

Beaverhead* = along Pioneer Byway
Beaverhead** = Chief Joseph Pass area
Lewis & Clark* = South Fork Sun area

Table 2. Mortality, Defoliation and Other Damage detected from the air on National Forests, National Parks and Tribal Lands in Montana, during 20010.

BEAVERHEAD NF					
Dillon RD	Acres	Trees			
Douglas-fir Beetle	32	155	MPB (High Elev 5-needle Pines)	1,997	7,980
Engelmann Spruce Beetle	4	10	Western Spruce Budworm	257	0
Mountain Pine Beetle (LPP)	78,091	340,997	Sula RD	Acres	Trees
Subalpine Fir Mortality	751	883	Douglas-fir Beetle	57	47
MPB (High Elev 5-needle Pines)	30,221	108,246	Pine Engraver Beetle (PP)	2	5
Western Spruce Budworm	18,748	0	Mountain Pine Beetle (PP)	538	1,092
Dieback	33	0	Mountain Pine Beetle (LPP)	9,917	33,645
Madison RD	Acres	Trees	Western Pine Beetle	4	2
Engelmann Spruce Beetle	4,263	34,023	Subalpine Fir Mortality	168	150
Mountain Pine Beetle (LPP)	25,136	71,953	MPB (High Elev 5-needle Pines)	182	651
Subalpine Fir Mortality	1,494	2,499	West Fork RD	Acres	Trees
MPB (High Elev 5-needle Pines)	4,423	9,668	Douglas-fir Beetle	905	2,972
Western Spruce Budworm	2,411	0	Mountain Pine Beetle (PP)	372	439
Windthrow	14	150	Mountain Pine Beetle (LPP)	45,334	202,546
Sheridan RD	Acres	Trees	Western Pine Beetle	2	1
Douglas-fir Beetle	10	70	Subalpine Fir Mortality	996	3,620
Engelmann Spruce Beetle	1,496	10,282	MPB (High Elev 5-needle Pines)	64	80
Mountain Pine Beetle (LPP)	13,725	43,914			
Subalpine Fir Mortality	1,284	1,995	CUSTER NF		
MPB (High Elev 5-needle Pines)	9,723	36,594	Beartooth RD	Acres	Trees
Western Spruce Budworm	1,329	0	Subalpine Fir Mortality	2	15
Wisdom RD	Acres	Trees	MPB (High Elev 5-needle Pines)	20	115
Mountain Pine Beetle (LPP)	60,492	167,861			
Subalpine Fir Mortality	20	140	DEERLODGE NF		
MPB (High Elev 5-needle Pines)	4,304	5,380	Butte RD	Acres	Trees
Western Spruce Budworm	112	0	Douglas-fir Beetle	36	70
Wise River RD			Mountain Pine Beetle (PP)	2	1
Douglas-fir Beetle	8	35	Mountain Pine Beetle (LPP)	38,887	120,572
Mountain Pine Beetle (LPP)	46,234	172,847	MPB (High Elev 5-needle Pines)	822	4,945
Subalpine Fir Mortality	30	135	Western Spruce Budworm	5,128	0
MPB (High Elev 5-needle Pines)	5,554	18,956	Deer Lodge RD	Acres	Trees
Western Spruce Budworm	1,036	0	Douglas-fir Beetle	16	35
			Mountain Pine Beetle (PP)	335	3,332
BITTERROOT NF			Mountain Pine Beetle (LPP)	57,968	467,985
Darby RD	Acres	Trees	Subalpine Fir Mortality	28	30
Douglas-fir Beetle	226	203	MPB (High Elev 5-needle Pines)	13,647	84,284
Engelmann Spruce Beetle	2	1	Western Spruce Budworm	380	0
Mountain Pine Beetle (PP)	499	1,000	Jefferson RD	Acres	Trees
Mountain Pine Beetle (LPP)	7,573	26,317	Douglas-fir Beetle	10	22
Western Pine Beetle	2	1	Mountain Pine Beetle (PP)	281	434
Subalpine Fir Mortality	64	88	Mountain Pine Beetle (LPP)	82,954	265,182
MPB (High Elev 5-needle Pines)	410	3,071	Subalpine Fir Mortality	4	40
Stevensville RD	Acres	Trees	MPB (High Elev 5-needle Pines)	5,040	12,524
Douglas-fir Beetle	97	123	Western Spruce Budworm	563	0
Mountain Pine Beetle (PP)	721	698	Philipsburg RD	Acres	Trees
Mountain Pine Beetle (LPP)	7,717	28,146	Douglas-fir Beetle	67	121
Subalpine Fir Mortality	899	5,343	Mountain Pine Beetle (PP)	1,279	388
			Mountain Pine Beetle (LPP)	61,520	654,339
			Subalpine Fir Mortality	393	1,976

MPB (High Elev 5-needle Pines)	2,776	10,722	MPB (High Elev 5-needle Pines)	2,110	5,152
Western Spruce Budworm	1,973	0	Western Spruce Budworm	8,361	0
			Unidentified Defoliator	136	0
FLATHEAD NF			Bozeman RD	Acres	Trees
Glacier View RD	Acres	Trees	Douglas-fir Beetle	263	1,239
Douglas-fir Beetle	74	77	Mountain Pine Beetle (LPP)	72,150	309,912
Engelmann Spruce Beetle	8	4	Subalpine Fir Mortality	1,127	3,187
Mountain Pine Beetle (WP)	2	1	MPB (High Elev 5-needle Pines)	15,991	61,521
Mountain Pine Beetle (PP)	8	4	Western Spruce Budworm	9,824	0
Mountain Pine Beetle (LPP)	1,235	1,105	Windthrow	683	98,366
Fir Engraver Beetle	20	14	Dieback	4	0
Subalpine Fir Mortality	4,436	8,475	Gardiner RD	Acres	Trees
MPB (High Elev 5-needle Pines)	301	133	Douglas-fir Beetle	48	248
Western Spruce Budworm	8,913	0	Mountain Pine Beetle (LPP)	8,600	44,221
Hungry Horse RD	Acres	Trees	Subalpine Fir Mortality	43	225
Douglas-fir Beetle	313	435	MPB (High Elev 5-needle Pines)	2,475	15,541
Engelmann Spruce Beetle	6	4	Western Spruce Budworm	4,334	0
Mountain Pine Beetle (PP)	8	4	Hebgen Lake RD	Acres	Trees
Mountain Pine Beetle (LPP)	9,597	42,855	Douglas-fir Beetle	1,555	2,144
Fir Engraver Beetle	82	112	Mountain Pine Beetle (LPP)	13,285	32,134
Subalpine Fir Mortality	310	642	Subalpine Fir Mortality	28	425
MPB (High Elev 5-needle Pines)	9	24	MPB (High Elev 5-needle Pines)	3,864	12,779
Western Spruce Budworm	21,349	0	Western Spruce Budworm	4,471	0
Lophodermella concolor	0	0	Dieback	34	0
Spotted Bear RD	Acres	Trees	Livingston RD	Acres	Trees
Douglas-fir Beetle	570	695	Douglas-fir Beetle	368	1,459
Engelmann Spruce Beetle	2	1	Mountain Pine Beetle (PP)	2	5
Mountain Pine Beetle (PP)	4	11	Mountain Pine Beetle (LPP)	36,093	134,430
Mountain Pine Beetle (LPP)	53,287	268,409	Subalpine Fir Mortality	259	967
Fir Engraver Beetle	10	11	MPB (High Elev 5-needle Pines)	20,019	85,533
Subalpine Fir Mortality	1,303	4,096	Western Spruce Budworm	6,360	0
MPB (High Elev 5-needle Pines)	3,271	11,286	Windthrow	283	5,721
Western Spruce Budworm	5,427	0	Dieback	6	0
Swan Lake RD	Acres	Trees			
Douglas-fir Beetle	164	239	HELENA NF		
Engelmann Spruce Beetle	6	4	Helena RD	Acres	Trees
Mountain Pine Beetle (PP)	1,127	552	Douglas-fir Beetle	8	11
Mountain Pine Beetle (LPP)	12,715	16,033	Mountain Pine Beetle (PP)	46,781	81,231
Fir Engraver Beetle	41	67	Mountain Pine Beetle (LPP)	144,482	828,379
Subalpine Fir Mortality	1,104	2,657	Subalpine Fir Mortality	11	50
MPB (High Elev 5-needle Pines)	4	4	MPB (High Elev 5-needle Pines)	3,371	9,375
Western Spruce Budworm	450	0	Western Spruce Budworm	12,491	0
Lophodermella concolor	281	0	Lincoln RD	Acres	Trees
Larch Needle Blight	50	0	Douglas-fir Beetle	10	17
Flooding - High Water	4	15	Pine Engraver Beetle (PP)	2	15
Tally Lake RD	Acres	Trees	Mountain Pine Beetle (PP)	3,989	17,671
Mountain Pine Beetle (LPP)	2	3	Mountain Pine Beetle (LPP)	87,776	909,273
Subalpine Fir Mortality	209	180	Subalpine Fir Mortality	18	66
Western Spruce Budworm	9	0	MPB (High Elev 5-needle Pines)	687	2,358
			Western Spruce Budworm	14,026	0
GALLATIN NF			Townsend RD	Acres	Trees
Big Timber RD	Acres	Trees	Douglas-fir Beetle	10	8
Douglas-fir Beetle	2,608	6,148	Mountain Pine Beetle (PP)	2,407	3,735
Mountain Pine Beetle (LPP)	5,357	12,911	Mountain Pine Beetle (LPP)	74,404	352,932
Subalpine Fir Mortality	33	195	Subalpine Fir Mortality	10	30

MPB (High Elev 5-needle Pines)	8,152	8,515	Subalpine Fir Mortality	656	1,195
Western Spruce Budworm	12,259	0	Western Spruce Budworm	3,510	0
KOOTENAI NF			LEWIS and CLARK NF		
Cabinet RD	Acres	Trees	Judith RD	Acres	Trees
Douglas-fir Beetle	105	271	Douglas-fir Beetle	877	685
Mountain Pine Beetle (PP)	26	35	Mountain Pine Beetle (PP)	2,666	6,586
Mountain Pine Beetle (LPP)	10,519	84,079	Mountain Pine Beetle (LPP)	35,913	138,172
Fir Engraver Beetle	4	13	Subalpine Fir Mortality	192	703
Subalpine Fir Mortality	2	1	MPB (High Elev 5-needle Pines)	619	2,609
MPB (High Elev 5-needle Pines)	2	2	Western Spruce Budworm	6,334	0
Western Spruce Budworm	13,569	0	Windthrow	5	20
Fisher River RD	Acres	Trees	Avalanche	50	200
Douglas-fir Beetle	64	130	Kings Hill RD	Acres	Trees
Mountain Pine Beetle (WP)	2	5	Douglas-fir Beetle	88	150
Mountain Pine Beetle (PP)	100	62	Pine Engraver Beetle (PP)	4	40
Mountain Pine Beetle (LPP)	2,663	20,547	Mountain Pine Beetle (PP)	16,589	102,382
Western Pine Beetle	8	4	Mountain Pine Beetle (LPP)	173,215	1,371,229
Fir Engraver Beetle	4	20	Subalpine Fir Mortality	241	713
Subalpine Fir Mortality	20	44	MPB (High Elev 5-needle Pines)	10,584	45,777
Western Spruce Budworm	18,766	0	Western Spruce Budworm	9,389	0
Fortine RD	Acres	Trees	Dieback	94	0
Douglas-fir Beetle	28	32	Musselshell RD	Acres	Trees
Engelmann Spruce Beetle	2	2	Douglas-fir Beetle	18	64
Mountain Pine Beetle (PP)	2	1	Mountain Pine Beetle (PP)	2,850	23,231
Mountain Pine Beetle (LPP)	14	43	Mountain Pine Beetle (LPP)	27,498	197,577
Fir Engraver Beetle	2	5	Subalpine Fir Mortality	4	35
Subalpine Fir Mortality	1,247	4,435	MPB (High Elev 5-needle Pines)	1,451	11,906
MPB (High Elev 5-needle Pines)	2	5	Western Spruce Budworm	3,858	0
Western Spruce Budworm	11,140	0	Windthrow	143	7,133
Libby RD	Acres	Trees	Rocky Mountain RD	Acres	Trees
Douglas-fir Beetle	48	62	Douglas-fir Beetle	2,840	7,076
Mountain Pine Beetle (WP)	8	6	Mountain Pine Beetle (PP)	2	3
Mountain Pine Beetle (PP)	36	42	Mountain Pine Beetle (LPP)	60,986	351,996
Mountain Pine Beetle (LPP)	191	746	Subalpine Fir Mortality	3,615	17,447
Western Pine Beetle	6	3	MPB (High Elev 5-needle Pines)	9,437	32,227
Fir Engraver Beetle	6	6	Western Spruce Budworm	5	0
Subalpine Fir Mortality	23	47	Flooding - High Water	11	10
Western Spruce Budworm	20,545	0	Dieback	57	0
Rexford RD	Acres	Trees	Lolo NF		
Douglas-fir Beetle	22	35	Missoula RD	Acres	Trees
Engelmann Spruce Beetle	2	1	Douglas-fir Beetle	17	25
Mountain Pine Beetle (WP)	2	1	Pine Engraver Beetle (PP)	6	12
Mountain Pine Beetle (PP)	37	46	Mountain Pine Beetle (PP)	577	678
Mountain Pine Beetle (LPP)	156	1,130	Mountain Pine Beetle (LPP)	23,356	52,242
Subalpine Fir Mortality	303	639	Western Pine Beetle	10	5
Western Spruce Budworm	3,810	0	Fir Engraver Beetle	4	4
Windthrow	19	186	Subalpine Fir Mortality	62	10
Three Rivers RD	Acres	Trees	Ninemile RD	Acres	Trees
Douglas-fir Beetle	90	128	Douglas-fir Beetle	36	27
Engelmann Spruce Beetle	8	10	Pine Engraver Beetle (PP)	4	20
Mountain Pine Beetle (WP)	4	4	Mountain Pine Beetle (PP)	484	574
Mountain Pine Beetle (PP)	8	10	Mountain Pine Beetle (LPP)	4,606	8,576
Mountain Pine Beetle (LPP)	182	627	Western Pine Beetle	12	8
Fir Engraver Beetle	24	42			

Fir Engraver Beetle	4	2	Western Spruce Budworm	1,261	0
Subalpine Fir Mortality	8	20			
MPB (High Elev 5-needle Pines)	6	5	FLATHEAD IR	Acres	Trees
Western Spruce Budworm	119	0	Diplodia Canker	1,573	0
Larch Needle Blight	22	0	Douglas-fir Beetle	10	16
Plains RD	Acres	Trees	Fir Engraver Beetle	4	7
Douglas-fir Beetle	25	33	Larch Casebearer	117	0
Mountain Pine Beetle (PP)	459	343	Larch Needle Cast	24	0
Mountain Pine Beetle (LPP)	3,442	6,314	Mountain Pine Beetle (LPP)	1,780	6,537
Western Pine Beetle	6	3	Mountain Pine Beetle (PP)	885	1,150
Fir Engraver Beetle	14	17	Pine Engraver Beetle (PP)	67	105
Subalpine Fir Mortality	60	34	Subalpine Fir Mortality	10	22
Western Spruce Budworm	1,971	0	Unidentified Defoliator	30	0
Flooding - High Water	13	60	Western Pine Beetle	24	12
Seeley Lake RD	Acres	Trees	Western Spruce Budworm	212	0
Douglas-fir Beetle	8	22	Winter Injury	119	0
Engelmann Spruce Beetle	4	15			
Mountain Pine Beetle (PP)	806	3,425	FORT BELKNAP IR	Acres	Trees
Mountain Pine Beetle (LPP)	27,870	112,954	Mountain Pine Beetle (LPP)	740	1,355
Subalpine Fir Mortality	24	85	Mountain Pine Beetle (PP)	1,146	3,002
MPB (High Elev 5-needle Pines)	163	191	MPB (High Elev 5-needle Pines)	4	20
Western Spruce Budworm	215	0			
Superior RD	Acres	Trees	ROCKY BOYS IR	Acres	Trees
Douglas-fir Beetle	8	13	Douglas-fir Beetle	2	15
Mountain Pine Beetle (PP)	270	328	Mountain Pine Beetle (LPP)	5,280	19,697
Mountain Pine Beetle (LPP)	461	907	Mountain Pine Beetle (PP)	2,727	6,646
Subalpine Fir Mortality	4	3	Western Spruce Budworm	279	0
MPB (High Elev 5-needle Pines)	4	10			
Western Spruce Budworm	2,730	0	GLACIER NP	Acres	Trees
Thompson Falls RD	Acres	Trees	Douglas-fir Beetle	362	344
Douglas-fir Beetle	10	15	Engelmann Spruce Beetle	2	1
Mountain Pine Beetle (PP)	20	11	Fir Engraver Beetle	6	4
Mountain Pine Beetle (LPP)	374	449	Lophodermella concolor	769	0
Western Pine Beetle	2	1	Mountain Pine Beetle (LPP)	11,541	64,230
Fir Engraver Beetle	2	5	Subalpine Fir Mortality	2,038	10,891
Subalpine Fir Mortality	7	19	Western Spruce Budworm	9,578	0
Western Spruce Budworm	188	0			
			YELLOWSTONE NP	Acres	Trees
BLACKFEET IR	Acres	Trees	Douglas-fir Beetle	1,651	4,407
Dieback	5,863	0	Flooding - High Water	14	105
Douglas-fir Beetle	213	605	Mountain Pine Beetle (LPP)	12,164	31,553
Lophodermella concolor	1,225	0	MPB (High Elev 5-needle Pines)	19,722	45,272
Mountain Pine Beetle (LPP)	3,092	12,412	Subalpine Fir Mortality	62	260
MPB (High Elev 5-needle Pines)	10	25	Unidentified Defoliator	2,821	0
Subalpine Fir Mortality	235	1,157	Western Spruce Budworm	18,121	0

COMMON AND SCIENTIFIC NAMES

Common Name	Pathogens	Primary Hosts
Annosus root disease	<i>Heterobasidion annosum</i> (Fr.:Fr.) Bref.	DF, GF, PP, SAF
Armillaria root disease	<i>Armillaria ostoyae</i> (Romagn.) Herink	DF, GF, SAF, saplings of all conifers
Black stain root disease	<i>Leptographium wageneri</i> (Kendrick) M.J. Wingfield	DF, PP
Comandra rust	<i>Cronartium comandrae</i> Pk.	LPP, PP
Cytospora canker	<i>Cytospora abietis</i> Sacc.	DF, GF, SAF
Diplodia shoot blight	<i>Diplodia pinea</i> (Desmaz.) J. Kickx fil.	PP
Dutch Elm Disease	<i>Ceratocystis ulmi</i> (Buisman) C. Moreau	Elms
Dwarf mistletoes	<i>Arceuthobium</i> spp.	DF, LP, LPP, WL
Elytroderma needle cast	<i>Elytroderma deformans</i> (Weir) Darker	PP
Fir broom rust	<i>Melampsorella caryophyllacearum</i> Schroet.	GF, SAF
Indian paint fungus	<i>Echinodontium tinctorium</i> (Ell. & Ev.) Ell. & Ev.	GF, WH
Laminated root rot	<i>Phellinus weirii</i> (Murrill) R.L. Gilbertson.	DF, GF, SAF, WH
Larch needle blight	<i>Hypodermella laricis</i> Tub.	WL
Larch needle cast	<i>Meria laricis</i> Vuill.	WL
Lodgepole pine needle cast	<i>Lophodermella concolor</i> (Dearn.) Darker	LPP
Red belt fungus	<i>Fomitopsis pinicola</i> (Schwartz :Fr.) Cooke	Conifers
Red ring rot	<i>Phellinus pini</i> (Thore :Fr.) A.Ames	DF, ES, PP, WL
Schweinitzii root and butt rot	<i>Phaeolus schweinitzii</i> (Fr. :Fr.) Pat.	Mainly DF, all conifers
Spruce broom rust	<i>Chrysomyxa arctostaphyli</i> Diet.	ES
Tomentosus root disease	<i>Inonotus tomentosus</i> (Fr.) Teng.	ES, DF, LPP, WL
White pine blister rust	<i>Cronartium ribicola</i> J.C. Fisch.	LP, WBP, WWP

Common Name	Insects	Primary Hosts
Balsam woolly adelgid	<i>Adelges piceae</i> Ratzeburg	GF, SAF
Douglas-fir beetle	<i>Dendroctonus pseudotsugae</i> Hopkins	DF
Douglas-fir tussock moth	<i>Orygia pseudotsugata</i> (McDunnough)	DF, ES, TF
Fir engraver beetle	<i>Scolytis ventralis</i> LeConte	GF, SAF
Gypsy moth	<i>Lymantria dispar</i> (Linnaeus)	Most hardwoods
Larch casebearer	<i>Coleophora laricella</i> (Hubner)	WL
Mountain pine beetle	<i>Dendroctonus ponderosae</i> Hopkins	All pines
Pine engraver beetle	<i>Ips pini</i> (Say)	LPP, PP
Spruce beetle	<i>Dendroctonus rufipennis</i> Swaine	ES
Western balsam bark beetle	<i>Dryocoetes confuses</i> Swaine	SAF
Western pine beetle	<i>Dendroctonus brevicornis</i> LeConte	PP
Western pine (Grizzled) tussock moth	<i>Dasychira pinicola</i> (Dyar)	PP (DF, ES, GF, LPP, SAF, WL)

DF = Douglas-fir; GF = Grand fir; TF = True fir; SAF = Subalpine fir; PP = Ponderosa pine; LP = Limber pine; LPP = Lodgepole pine; WWP = Western white pine; ES = Engelmann spruce; WH = Western hemlock; WL = Western larch; WBP = Whitebark pine

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**Table 3. Acres of Host Type Infested by Bark Beetles
on all Ownerships in Montana during 2010**

	USFS	Other Fed	Private	State	Total
Insect	Acres	Acres	Acres	Acres	Acres
DFB¹	10,934	2,723	1,933	462	16,052
ESB¹	5,790	10	20	7	5,827
FE¹	207	7	70	2	286
IPS¹	10	57	128	2	197
MPB-LPP¹	1,315,849	114,343	202,220	40,075	1,672,487
MPB-PP¹	67,886	29,941	173,185	25,783	296,795
MPB-5-NP¹	147,754	22,139	19,866	543	190,302
MPB-WWP¹	10	0	8	0	18
MPB-All¹	1,531,499	166,423	395,279	66,401	2,159,602
SAF¹	20,455	2,345	890	209	23,899
WPB¹	40	16	40	12	108
WSBW	201,614	41,087	85,404	13,397	341,502

¹DFB = Douglas-fir beetle; ESB = Spruce beetle; FE = Fir engraver beetle; IPS = Pine engraver beetle;
MPB LPP = Mountain pine beetle in Lodgepole pine; MPB PP = Mountain Pine Beetle in Ponderosa pine;
MPB 5-NP = Mountain pine beetle in 5-Needle pines (WBP & LP); MPB WP = Mountain pine beetle in Western white pine;
MPB All = Mountain pine beetle in all pines; SAF = Subalpine fir mortality complex; WPB = Western pine beetle;
WSBW = Western spruce budworm.

Table 4. Acres and Number of trees of Host Type Infested by Bark Beetles in Montana, 2008 Through 2010

	2008 ^{2,3}		2009 ^{2,3}		2010 ^{2,3}	
Insect	Acres	Trees	Acres	Trees	Acres	Trees
DFB¹	21,558	39,587	22,528	52,873	16,052	31,219
ESB¹	54	60	72	100	5,827	44,390
FE¹	359	803	9,187	7,842	286	393
IPS¹	10,778	36,669	805	1,751	197	1,459
MPB¹	1,819,245	16,903,542	3,694,164	22,259,733	2,159,602	10,910,673
SAF¹	53,194	149,802	82,505	245,595	23,899	75,793
WPB¹	167	182	816	1,302	108	57
TOTAL	1,905,355	17,130,645	3,810,077	22,569,196	2,205,971	11,063,984

¹DFB = Douglas-fir beetle; ESB = Spruce beetle; FE = Fir engraver beetle; IPS = Pine engraver beetle;

MPB = Mountain pine beetle; SAF = Subalpine fir mortality complex; WPB = Western pine beetle.

²Not all areas were flown due to fires, inclement weather or seasonal limitations.

³Yellowstone NP includes MT, ID and WY acres.

Table 5. Acres with Douglas-fir Beetle-Caused Mortality on All Ownerships in Montana, 2008 Through 2010

	2008		2009		2010	
Reporting Area	Acres	Trees	Acres	Trees	Acres	Trees
Beaverhead	376	1,766	87	480	56*	280*
Bitterroot	674*	1,933*	229	436	1,345	3,415
Custer	85*	163*	2,941	7,552	★	★
Deerlodge	411	1,219	539	2,175	206*	402*
Flathead	7,899	12,844	4,969	8,797	1,160*	1,506*
Gallatin	722*	3,515*	2,446	10,302	5,313*	13,072*
Garnets	283	650	122	236	36*	84*
Helena	5,166*	3,859*	1,707	1,062	105*	103*
Kootenai	205*	289*	466*	684*	373*	682*
Lewis & Clark	937*	2,075*	3,382	14,418	5,091*	9,680*
Lolo	2,364	6,772	1,626*	2,416*	129*	167*
Blackfeet IR	55	68	582	61	213	605
Crow IR	★	★	125	96	★	★
Flathead IR	51*	73*	259	254	10*	16*
Fort Belknap IR	0	0	6*	6*	0	0
No. Cheyenne IR	★	★	0	0	★	★
Rocky Boy's IR	18	56	24	60	2	15
Glacier NP	2,146	3,950	2,939*	3,598*	362	344
Yellowstone NP	166	355	79	240	1,651	4,407
TOTAL	21,718	39,587	22,528	52,873	16,052	34,778

★ = Not surveyed * = Partially surveyed

Yellowstone NP includes acres in MT, ID and WY

**Table 6. Acres with Mountain Pine Beetle-Caused Mortality on State and Private Lands
in Montana, 2008 Through 2010**

	2008				2009				2010			
Reporting Area	LPP ¹	PP ¹	5-NP ¹	WWP ¹	LPP ¹	PP ¹	5-NP ¹	WWP ¹	LPP ¹	PP ¹	5-NP ¹	WWP ¹
Beaverhead	26,874	0	3,064	0	31,580	0	4,095	0	14,912*	0*	970*	0*
Bitterroot	36*	61*	0*	0*	424	890	0	0	1,385	1,073	6	0
Custer	63*	527*	3*	0*	10	67	32	0	★	★	★	★
Deerlodge	79,935	834	5,435	0	97,179	2,602	2,289	0	43,923*	686*	7,988*	0*
Flathead	2,619	795	2	0	4,172	752	0	0	3,904*	498*	4*	0*
Gallatin	32,811*	21*	16,467*	0*	152,091	0	27,297	0	49,652*	4*	7,991*	0*
Garnets	25,712	1,922	105	0	35,560	28,315	0	0	25,546*	19,809*	0*	0*
Helena	55,354*	24,009*	105*	0*	136,546	178,360	2,836	0	62,367*	137,965*	2,336*	0*
Kootenai	951*	148*	0*	0*	1,894*	217*	0*	4*	1,938*	45*	0*	8*
Lewis & Clark	4,191*	1,899*	183*	0*	30,605	50,617	2,877	0	26,505*	29,185*	937*	0*
Lolo	11,079	531	0	0	31,478*	10,777*	0*	0*	9,785*	6,608*	177*	0*
Blackfeet IR	44	0	0	0	132	0	0	0	680	0	0	0
Crow IR	★	★	★	★	0	29	0	0	★	★	★	★
Flathead IR	431*	203*	0*	0*	987	662	0	0	41*	173*	0*	0*
Fort Belknap IR	2	30	0	0	10*	22*	0*	0*	61	697	0	0
No. Cheyenne IR	★	★	★	★	0	2	0	0	★	★	★	★
Rocky Boy's IR	561	258	0	0	1,507	132	0	0	1,505	2,225	0	0
Glacier NP	190	0	0	0	16*	0*	0*	0*	91	0	0	0
Yellowstone NP	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	240,853	31,238	25,364	0	524,191	273,444	39,426	4	242,295	198,968	20,409	8

¹LPP = Lodgepole pine; PP = Ponderosa pine; 5-NP = 5-needle pines (WBP & LP); WWP = Western white pine

★ = Not surveyed; * = Partially surveyed; Yellowstone NP includes MT, ID, and WY acres

**Table 7. Acres with Mountain Pine Beetle-Caused Mortality on All Federal Ownerships
in Montana, 2008 Through 2010**

	2008				2009				2010			
Reporting Area	LPP ¹	PP ¹	5-NP ¹	WWP ¹	LPP ¹	PP ¹	5-NP ¹	WWP ¹	LPP ¹	PP ¹	5-NP ¹	WWP ¹
Beaverhead	220,579	0	71,414	0	265,158	0	116,697	0	235,848*	0*	54,069*	0*
Bitterroot	8,083*	297*	1,384*	0*	12,703	705	2,959	0	69,343	1,648	2,651	0
Custer	3,277*	476*	1,110*	0*	819	196	8,538	0	★	★	★	★
Deerlodge	458,193	745	18,733	0	539,967	2,935	19,120	0	220,921*	2,061*	18,829*	0*
Flathead	19,058	39	21	0	31,567	398	111	0	73,260*	854*	3,581*	2*
Gallatin	66,374*	5*	67,135*	0*	248,320	0	127,601	0	98,259*	0*	37,264*	0*
Garnets	44,374	82	0	0	53,578	2,057	0	0	47,093*	3,727*	0*	0*
Helena	263,767*	13,054*	4,088*	0*	459,157	104,332	12,471	0	295,815*	68,308*	11,578*	0*
Kootenai	5,956*	116*	0*	0*	45,284*	869*	10*	18*	11,911*	174*	4*	8*
Lewis & Clark	38,528*	2,248*	9,961*	0*	305,791	24,741	36,305	0	289,956*	17,286*	22,181*	0*
Lolo	119,425	775	44	0	294,013*	12,134*	50*	4*	55,567*	2,106*	0*	0*
Blackfeet IR	623	0	0	0	452	4	0	0	2,412	0	10	0
Crow IR	★	★	★	★	4	60	14	0	★	★	★	★
Flathead IR	2,371*	537*	0*	0*	15,946	2,044	160	0	1,739*	712*	0*	0*
Fort Belknap IR	137	598	0	0	226*	500*	0*	0*	679	449	4	0
No. Cheyenne IR	★	★	★	★	0	113	2	0	★	★	★	★
Rocky Boy's IR	1,718	190	0	0	4,231	437	0	0	3,775	502	0	0
Glacier NP	20,786	2	0	0	4,434*	2*	6*	0*	11,450	0	0	0
Yellowstone NP	25,535	2	29,950	0	58,393	462	41,001	0	12,164	0	19,722	0
TOTAL	1,298,784	19,166	203,840	0	2,340,043	151,989	365,045	22	1,430,192	97,827	169,893	10

¹LPP = Lodgepole pine; PP = Ponderosa pine; 5-NP = 5-needle pines (WBP & LP); WWP = Western white pine

★ = Not surveyed; * = Partially surveyed; Yellowstone NP includes MT, ID, and WY acres

**Table 8. Acres with Additional Bark Beetle-Caused Mortality on All Ownerships
in Montana, 2008 Through 2010**

	Engelmann Spruce			Fir Engraver Beetle			Pine Engraver Beetle			Subalpine fir Mortality			Western Pine Beetle		
Reporting Area	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Beaverhead	0	6	5,785*	0	0	0*	0	0	0*	464	554	3,582*	0	0	0*
Bitterroot	4*	0	2	0*	18	0	2*	4	2	2,838	5,589	2,126	24*	0	20
Custer	0*	0	★	0*	0	★	431*	0	★	2,449*	771	★	0*	0	★
Deerlodge	2	0	0*	0	0	0*	0	0	0*	8,400	2,328	425*	2	2	2*
Flathead	24	32	22*	174	494	163*	0	2	0*	16,393	13,038	7,410*	0	20	0*
Gallatin	0*	0	0*	0*	0	0*	4*	0	0*	14,054*	36,384	1,492*	0*	0	0*
Garnets	0	0	0*	31	0	0*	0	137	0*	9	0	4*	2	67	6*
Helena	4*	0	0*	0*	0	0*	9,995*	0	64*	16*	20	39*	0*	2	0*
Kootenai	10*	8*	12*	36*	333*	40*	12*	6*	0*	394*	6,139*	2,257*	4*	128*	16*
Lewis & Clark	2*	0	0*	0*	0	0*	176*	0	42*	1,341*	4,173	4,054*	0*	0	0*
Lolo	0	2*	4*	48	5,898*	73*	45	616*	22*	2,261	1529*	165*	107	575*	40*
Blackfeet IR	0	2	0	4	801	0	0	0	0	2	107	235	0	0	0
Crow IR	★	0	★	★	0	★	★	0	★	★	4	★	★	0	★
Flathead IR	0*	0	0*	2*	11	4*	4*	40	67*	99*	2,017	10*	28*	20	24*
Fort Belknap IR	0	0*	0	0	0*	0	65	0*	0	0	0*	0	0	0*	0
No. Cheyenne IR	★	0	★	★	0	★	★	0	★	★	0	★	★	0	★
Rocky Boy's IR	0	0	0	0	0	0	44	0	0	0	0	0	0	2	0
Glacier NP	4	4*	2	64	1,632*	6	0	0*	0	3,624	7,509*	2,038	0	0*	0
Yellowstone NP	4	18	0	0	0	0	0	0	0	850	2,343	62	0	0	0
TOTAL	54	72	5,827	359	9,187	286	10,778	805	197	53,194	82,505	23,899	182	816	108

★ = Not surveyed * = Partially surveyed

Yellowstone NP includes MT, ID and WY acres

Figure 2. Reporting Areas and County Boundaries in Montana

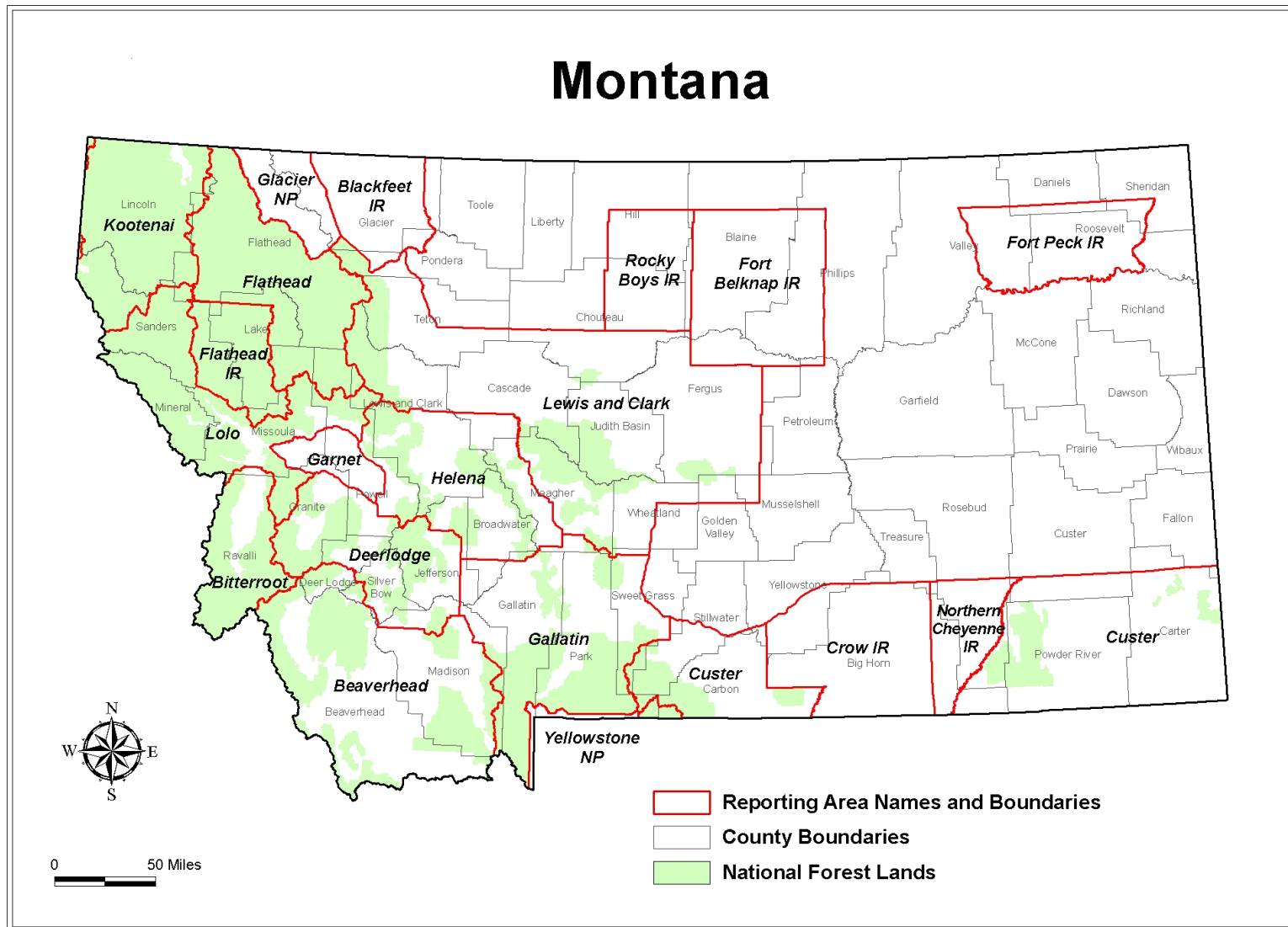


Figure 3. Areas Surveyed During the 2010 Forest Health Protection Aerial Detection Survey in Montana

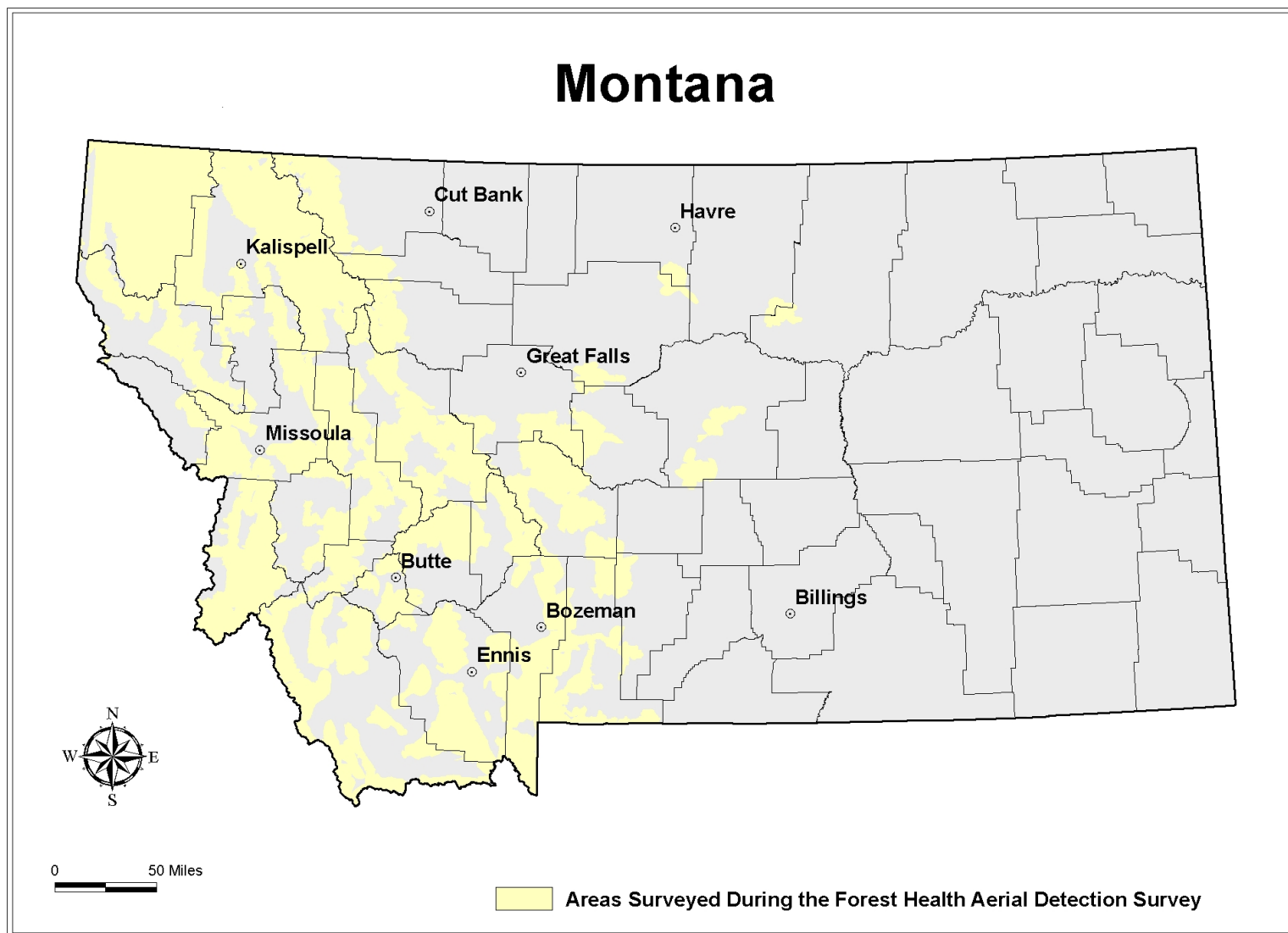


Figure 4. 2010 Mountain Pine Beetle Infestations in Montana

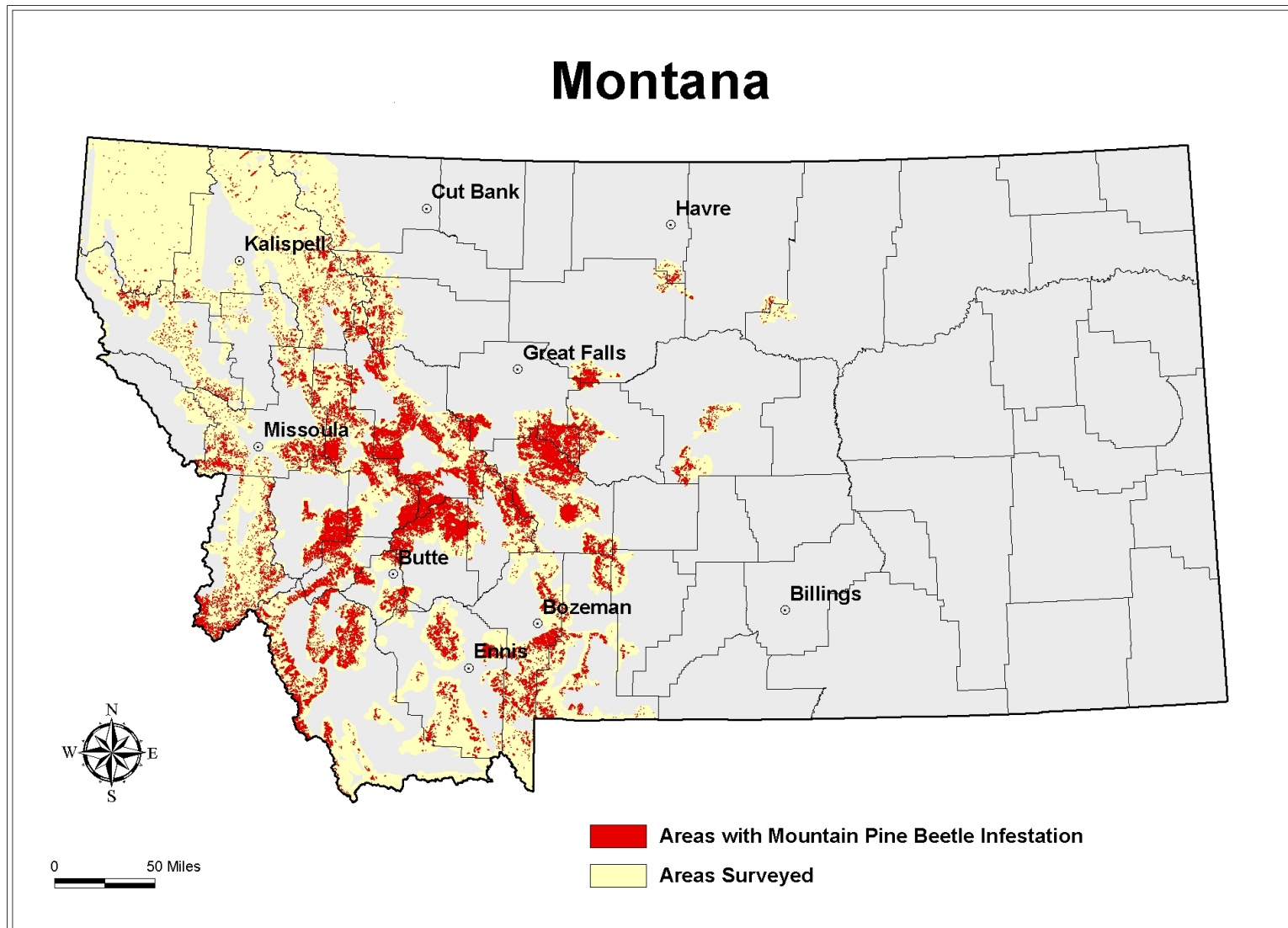


Figure 5. 2010 Douglas-fir Beetle Infestations in Montana

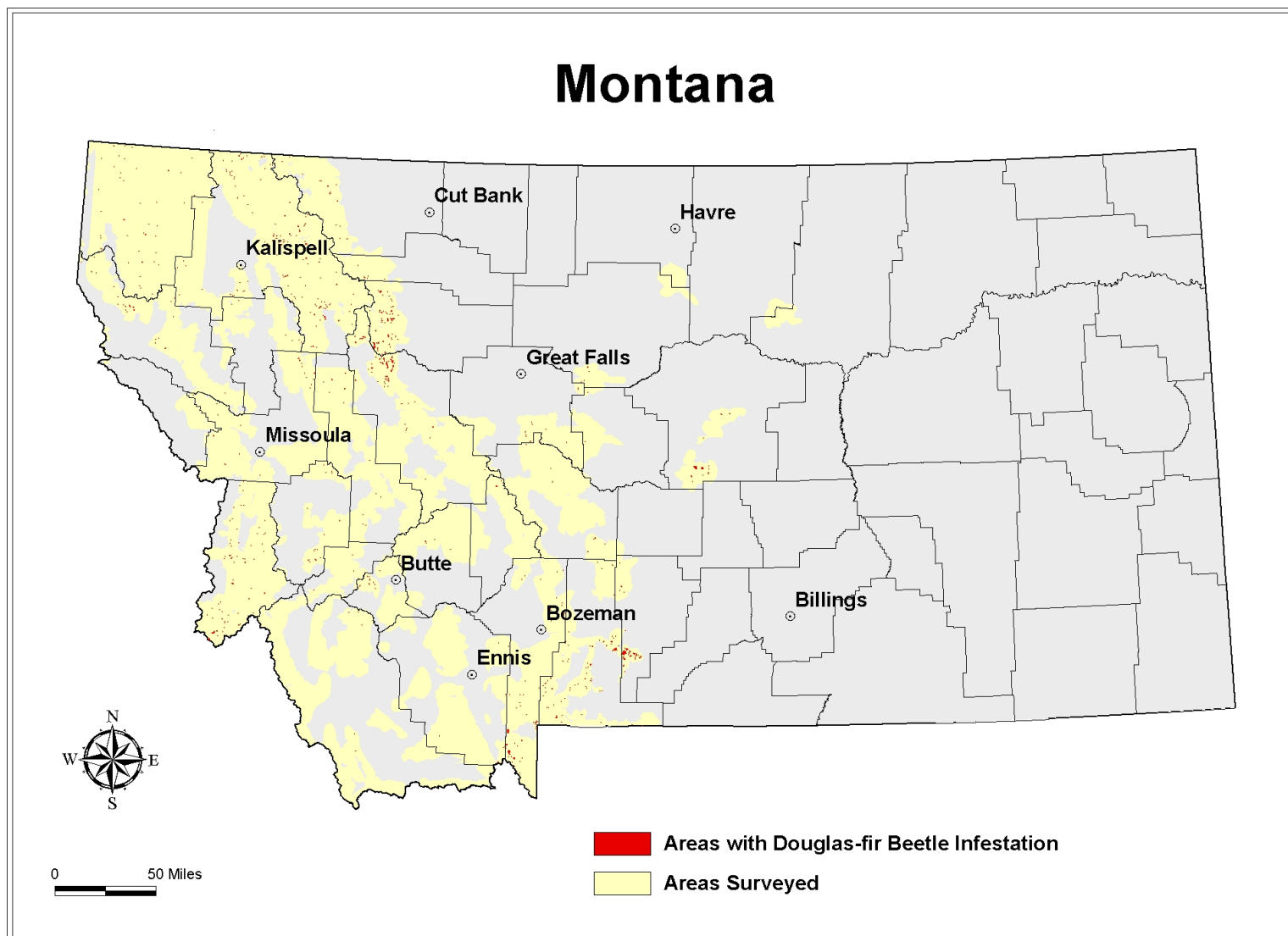


Figure 6. 2010 Fir Engraver Beetle Infestations in Montana

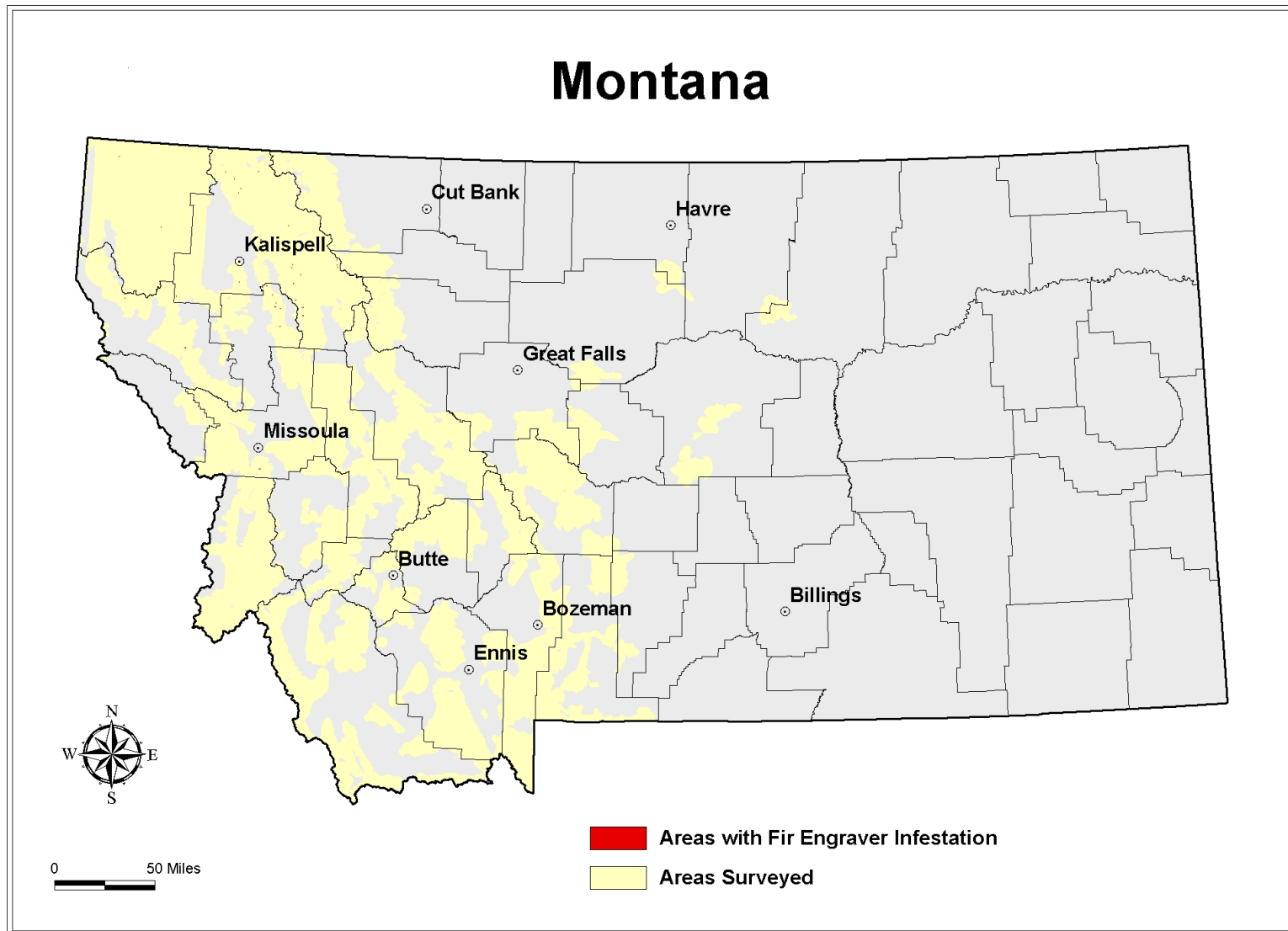


Figure 7. 2010 Subalpine Fir Mortality Complex in Montana

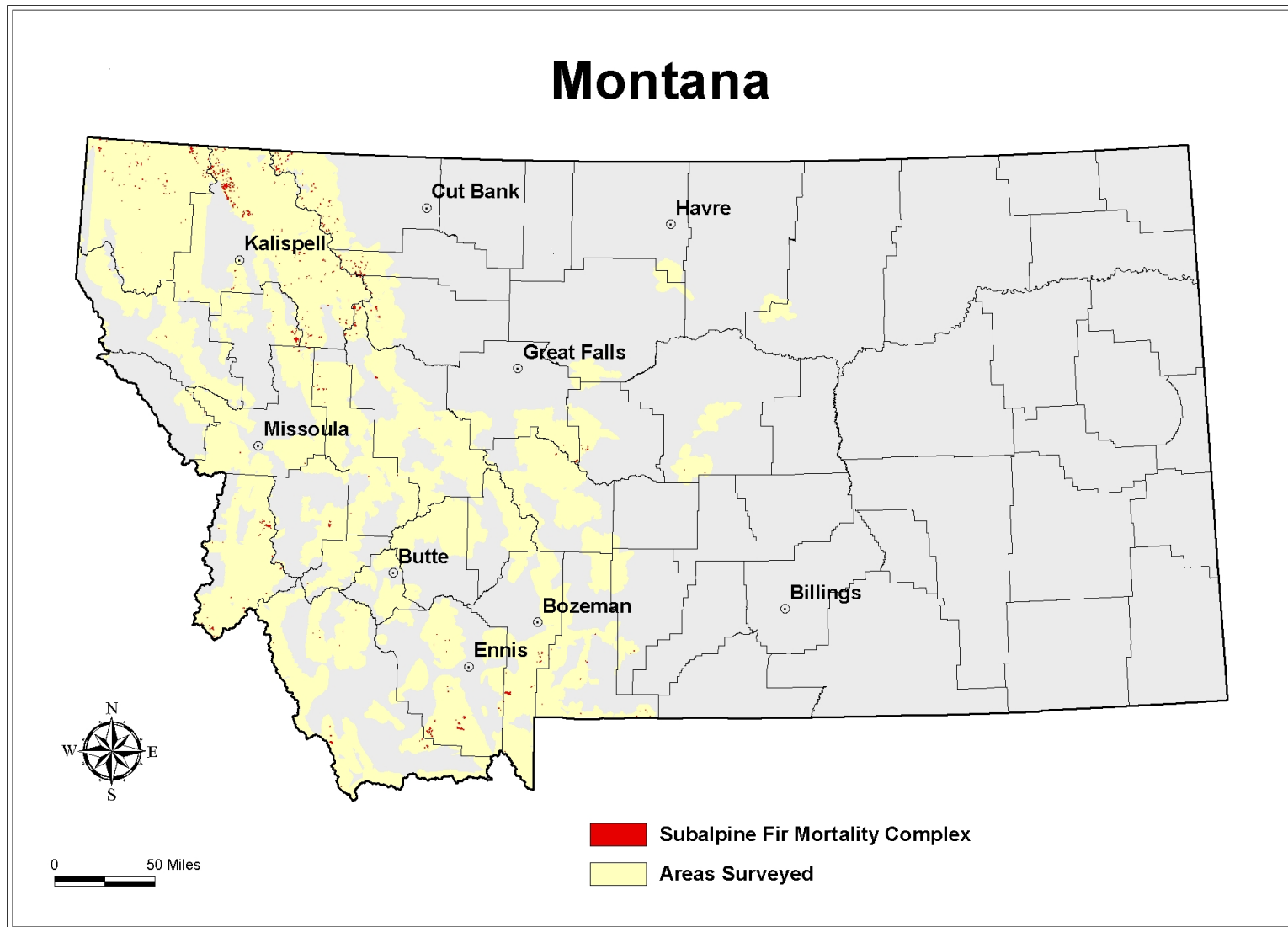


Figure 8. 2010 Western Spruce Budworm Infestations in Montana

